AVIATION WEEK

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Should the need arise again, the Cougar jet fighters above, plus other new Grumman Aircraft, will play as big a role in victory as did Panther jets in Korea . . . as did Grumman Wildcats, Hellcats and Avengers of task force fame in World War II.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION

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Sundstrand announces Automatic Paralleling!

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RELIABLE
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Another achievement in the field of constant frequency a-c electrical systems for aircraft comes from Sundstrand. The new automatic paralleling control shown above, when combined with the alternator drive system, produces a completely automatic electrical system.

This control takes over the job formerly done by the crew . . . and does it faster, safer, and better. It frees the crew's attention from the electrical system, permits other uses of their trained skill, and precludes the large synchronizing torques imposed on the drive train when paralleling is attempted with alternators out of phase.

Because it is based upon Sundstrand's unmatched frequency control of 400 CPS ± ¼%, the automatic paralleling control is remarkably simple, and therefore *reliable*. This same simplicity makes the control compact and light in weight. It measures only 3¾″ x 4¾″ x 3″ deep, and weighs but 1¾ lbs.

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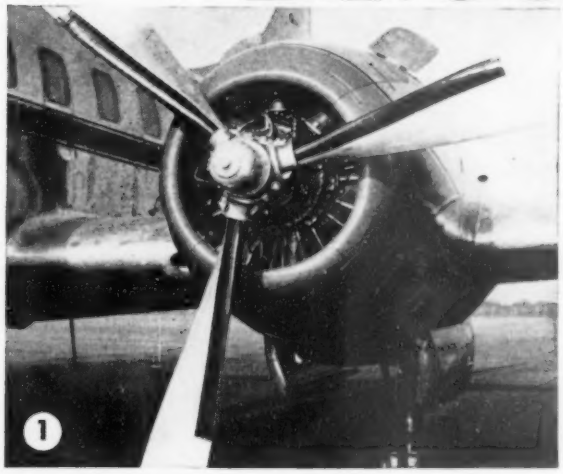

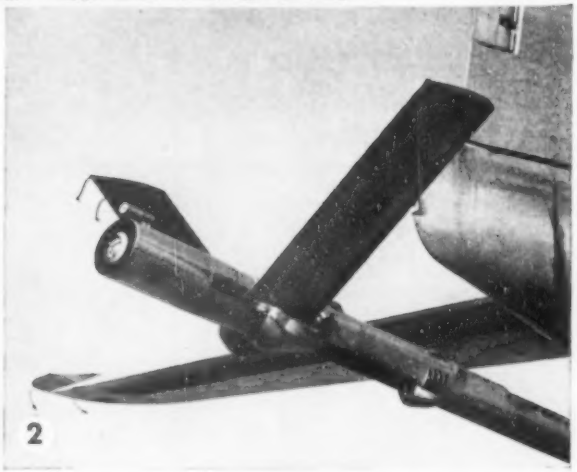

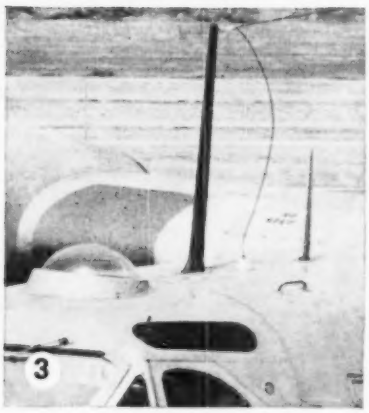

Everywhere the heat's on ice with B. F. Goodrich heated rubber

SUPPLYING ice protection for any size or shape of airplane part is no longer a problem. B. F. Goodrich engineers have developed a flexible electrically heated rubber that fits skin-tight over bulges, around tricky curves and corners.

A core of electric resistance wires running through the rubber supplies intense heat—either in cycles to loosen ice so the airstream can carry it away or constantly, to keep ice from forming. It depends on the particular icing problem. B. F. Goodrich heated rubber can be operated from the plane's regular power supply. It is the most efficient method of putting the right amount of heat on the right spot. It simplifies design, saves weight, can be cemented onto the part.

Here are some applications—all of different shapes—where BFG heated rubber has given successful ice protection:

1. *On propellers,* it prevents ice from reducing propeller efficiency and cutting down plane speed.

2. *On ruddevators,* it permits accurate control of Flying Boom for refueling in flight under icing conditions.

3. *On radio masts,* it keeps ice from forming and causing them to snap off in the wind.

4. *On air scoops,* it insures plentiful air supply for cabin heating systems and for cooling engine accessories.

5. *On elevator horns,* it keeps them from freezing tight, insures easy control.

B. F. Goodrich electrically heated rubber is also used on wings, hydraulic lines, water tanks, spinner domes, jet engine intakes, and many other airplane parts. It's a typical development of BFG's engineering and research for aviation. Other B. F. Goodrich aviation products: tires, wheels, brakes; De-Icers; Avtrim; inflatable seals; fuel cells; Rivnuts; accessories. *The B. F. Goodrich Company, Aeronautical Sales, Akron, Ohio.*

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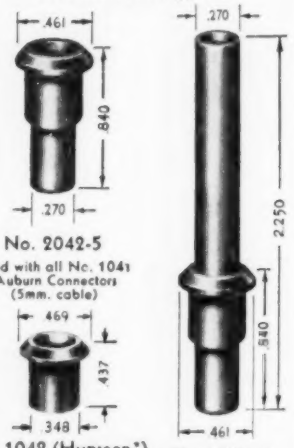
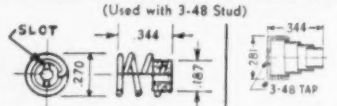


*Auburn Synthetic Rubber

SPRING AND EYELET ASSEMBLIES

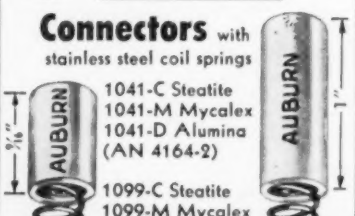
(Used with 3-48 Stud)



Teflon Connectors

with Inconel volute springs

Connectors with stainless steel coil springs



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Aviation Week

February 22, 1954 — Vol. 60, No. 8

Editorial Offices
New York 36—330 W. 42nd St., Phone LOngacre 4-3000 (Night, LO 4-3035)
Washington 4, D. C.—National Press Bldg., Phone NAtional 8-3414
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AVIATION WEEK • February 22, 1954 • Vol. 60, No. 8
Member ABP and ABC

Published weekly by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. **Publication Office: 99-129 North Broadway, Albany 1, N. Y.**
Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.
Subscriptions: Address correspondence to AVIATION WEEK—Subscription Service, 99-129 North Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 36, N. Y. Allow 10 days for change of address.
Subscriptions are solicited only from persons having a commercial or professional interest in aviation. Position and company connection must be indicated on subscription orders.
Single copies 50¢. Subscription rates—United States and possessions, $6 a year; $9 for two years; $12 for three years. Canada $8 a year; $12 for two years; $16 for three years, payable in Canadian currency at par; other Western Hemisphere, $10 a year; $16 for two years; $20 for three years. All other countries $20 a year; $30 for two years; $40 for three years. Entered as second-class matter, July 16, 1947, at the Post Office at Albany, N. Y., under Act of Mar. 3, 1879. Printed in U. S. A.

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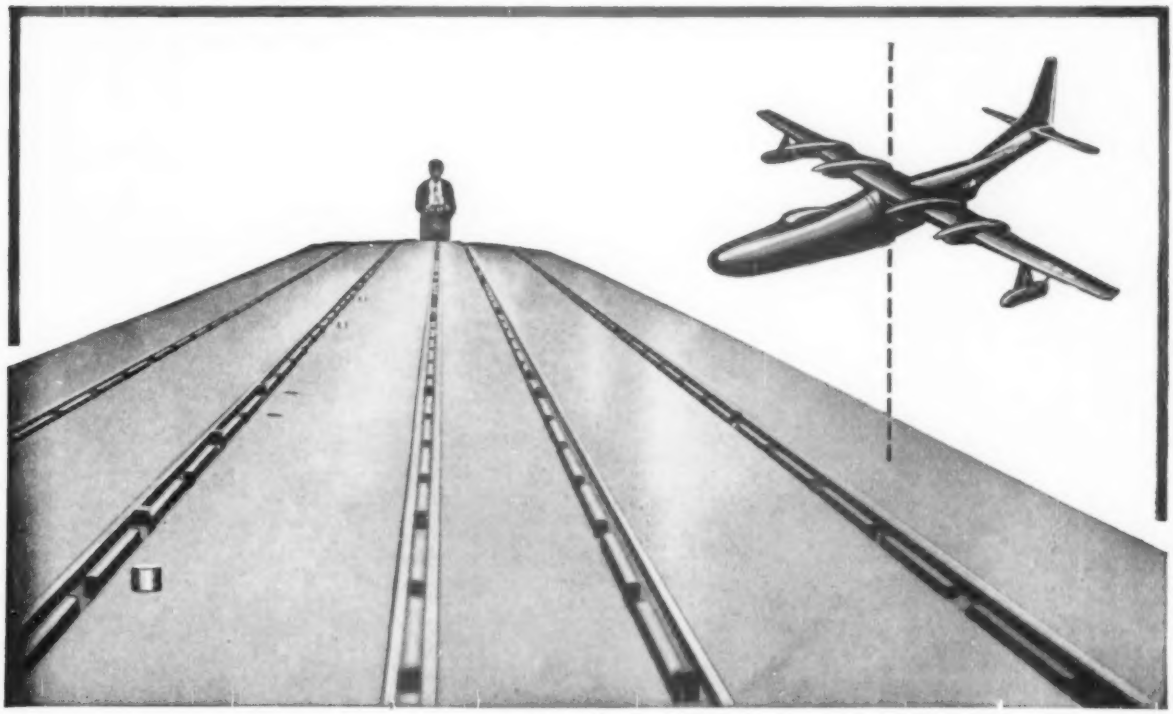
DOW

NAVY'S R3Y-1 FEATURES MAGNESIUM CARGO DECK

"Fastest flying boat" demonstrates extruded magnesium's combination of light weight and toughness for better flooring



MAGNESIUM EXTRUDED CARGO DECK SECTION *of the new Convair-built Navy R3Y-1 "Tradewind" now in production at San Diego. Magnesium provides the R3Y-1 with a tough, yet lightweight, easily installed cargo deck for heavy-duty service.*

In all its 40-year history, water-based aircraft has never been appraised in terms of speed or maneuverability. The big lumbering transports of past years were reputedly slow and cumbersome in flight. This was true primarily because of their great weight.

Today, however, Convair and the U. S. Navy present the "Tradewind" as the fastest flying boat in aviation history. Its turbo-prop engines provide a top speed of more than 350 mph . . . enable it to take off in 30 seconds with full load.

One factor that contributes greatly to the increased speed and easy handling of this giant seaplane is the extensive use of magnesium in its design. Take as an example, the cargo deck. It's made of magnesium ZK60A extrusion alloy. It's light in weight. (Magnesium is the world's lightest structural metal!) And it's strong and rugged enough for heaviest duty. This combination of qualities makes magnesium perfectly suited for this application.

There are other instances, too, in this and in other aircraft, where magnesium has helped designers solve some of their weight and speed problems. Have you considered magnesium for your uses? For more detailed information, contact your nearest Dow sales office, or write directly to THE DOW CHEMICAL COMPANY, Magnesium Department, Midland, Michigan.

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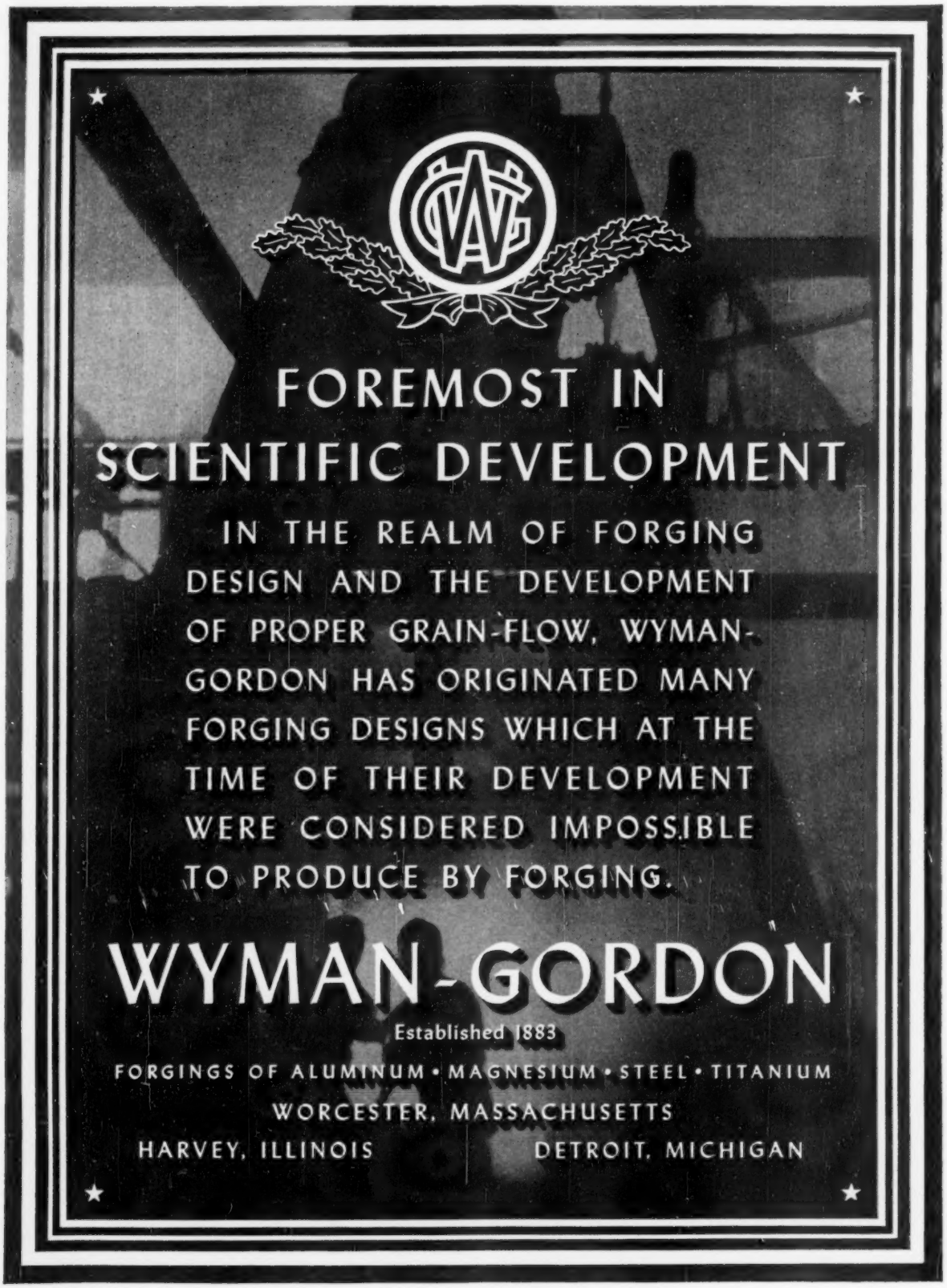
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IN THE REALM OF FORGING DESIGN AND THE DEVELOPMENT OF PROPER GRAIN-FLOW, WYMAN-GORDON HAS ORIGINATED MANY FORGING DESIGNS WHICH AT THE TIME OF THEIR DEVELOPMENT WERE CONSIDERED IMPOSSIBLE TO PRODUCE BY FORGING.
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NEWS DIGEST

Domestic

Ryan Model 72 has lost out in Navy's primary trainer competition because of its side-by-side seating (AVIATION WEEK Nov. 30, p. 42), Bureau of Aeronautics reports. A Navy spokesman says a change to side-by-side trainers could not be made because most Naval flight operations involve carrier-based aircraft, principally single-place or tandem. Ruling out Ryan leaves the decision between the Beech Mentor and Temco Plebe, with a winner "expected in the very near future."

Boeing Airplane Co. plans to begin building a $10-million test center for B-52s this year at Larson AFB, Wash.

Air route traffic control center in Cincinnati will move to Weir-Cook Airport at Indianapolis this summer to form part of Civil Aeronautics Administration's new Airways Operations Evaluation Center, set up to test and develop new traffic control aids and techniques.

Schweizer Aircraft Corp. has won a $1-million contract to produce a major fuselage section for Republic F-84Fs, estimates the new order will involve work at the Elmira (N. Y.) plant over the next two years.

Piasecki YH-16 would find wide use on shorthaul, intercity routes in Europe if its capacity were increased from 40 to 50 passengers, Sabena board chairman Gilbert Perier and president Felicien Pirson forecast during a tour of the copter builder's Morton (Pa.) plant.

New USAF contract involving "millions of dollars" has been won by Hudson Motor Car Co. for production of airframe components for Glenn L. Martin's B-57 night intruder. The Detroit company says the new order is approximately 90% of the size of existing B-57A contracts, estimates production will continue into 1955.

Two Convair RB-36s have flown 8,700 mi. nonstop from Japan to Limestone AFB, Me. Purpose: to study jetstream winds.

Martin 2-0-2s had an average load factor of 57% during their first seven month of operation by Southwest Airways Co., giving a passenger density of 20.0. This is nine passengers more than the airline's DC-3 density figure of 11.7 for the same period.

New spray/dust plane is being built by Callair at Afton, Wyo. The aircraft is similar in outline to Callair's two-three-place, low-wing A-2, but is a single-seater with a new cockpit layout. Spray/dust container is located next to the pilot.

Piper Apache Receives Type Certificate

William T. Piper (left), president of Piper Aircraft Corp., holds Civil Aeronautics Administration type certificate, recently awarded to the Apache twin-engine-business plane (background). Walter Jamouneau, Piper chief engineer (right), and William McNary, assistant chief engineer, receive congratulations. First commercial delivery of the all-metal Apache will be made this month. Price starts at $32,500.

Student and private pilots will be issued temporary third-class medical certificates, good for two years unless recalled within 90 days by an authorized CAA representative. The new system eliminates reviews of examiner's report after temporary certificates were issued.

Edward T. Stodola has resigned as senior hearing examiner for Civil Aeronautics Board, effective Mar. 15, to become chief, hearing examiner for the Federal Communications Commission.

Financial

Beech Aircraft Corp., Wichita, reports a net loss of $2,321,052 for fiscal 1953, blames expense of hiring and training personnel to produce T-36 trainers for USAF before the contract was canceled (AVIATION WEEK Dec. 21, p. 7). Net sales were $140,457,780, more than $49 million higher than the previous year. For the first quarter of fiscal 1954, net profit totaled $627,445, compared with $489,808 for the first three months of 1953. Net sales for the quarter dropped $3,113,561 to $21,158,855. Backlog as of Dec. 31: $102,080,000.

National Airlines had a net profit of $5,413,123 for 1953, an increase of $2,242,932. Earnings were boosted by equipment sales that totaled $3,963,-174, before taxes, during the final quarter of the calendar year.

Continental Aviation & Engineering Corp., Detroit, had net earnings of $325,101 from sales totaling $14,523,-719 during fiscal 1953, compared with a $268,993 net and sales of $9,261,589 the previous year.

Waco Aircraft Co., Troy, Ohio, reports net income of $124,822 for fiscal 1953, compared with $240,682 in fiscal 1952.

International

Nakajima Aircraft Co., Japanese industrial giant that was split into five companies at the end of World War II, is expected to be reformed by the middle of this year. First step toward reorganization was taken in 1953, when the five firms established Fuji Heavy Industries to handle U. S. and Japanese defense orders.

Pakistan International Airlines took delivery on its first Super Constellation last week at Lockheed Aircraft's Burbank (Calif.) headquarters, expects to put the transport into service between Dacca and Karachi in April.

Swiss air force has asked Parliament for authorization to purchase an additional 100 de Havilland Venom fighters at a total cost estimated at $30 million. First series of 150 jets was ordered in 1951.

as others see us . . .

A user tells how AETCO SERVICE helped him

Mr. S. R. Billingsley
Vice President-Engineering
Stratoflex, Inc.

In March of 1953, we forwarded samples of our new Stratoflex hose fittings in three sizes to AETCO. These were our 312-3, 312-5 and 312-32, all designed to Specification MIL-F-5070. AETCO was requested to conduct the Fire Resistance Tests on these parts as required by the military qualifying agency—Wright Air Development Center, Dayton, Ohio.

AETCO assigned their Project No. 57 and completed these tests, including witness by a USAF representative. Copies of their Test Report No. 57 were forwarded to WADC and Stratoflex.

Stratoflex has submitted several testing jobs on our products to AETCO and the above example serves to illustrate the value realized in time and expense. Most testing on our products is carried out in our own test laboratory, however, it has proved very worth while to avail ourselves of the facilities at AETCO regarding certain types of tests, or when our laboratory schedule is crowded.

I visited the Aircraft Equipment Testing Company in Baltimore prior to submitting work to them, and found them well equipped for our test jobs, and WADC approved AETCO to conduct such test work for Stratoflex.

Mr. H. P. Kupiec has personally coordinated our tests to insure that they are conducted exactly as required. His reports set forth the recorded results as obtained from each test. Such independent laboratory test results are very helpful for evaluation of our new Stratoflex products.

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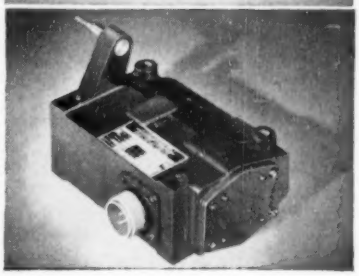
Airborne's
MAGNETIC BRAKE
Now speed governed



Airborne's geared magnetic brake is now available with an integral centrifugal brake to limit its speed and prevent overshooting. Designed to maintain any position within its travel range, the Model R-460 brake will hold a 200 lb. in. load, yet operate at less than 3 lb. in. when energized. A typical application is the centering adjustment of the bungee in the flight control system of a Piasecki Helicopter.

Small size and weight (2.3 lb.) make this brake unusually well suited to most aircraft. See the I.A.S. Aeronautical Engineering Catalog for dimensions of the R-460 or write us your requirements.

AIRBORNE
ACCESSORIES CORPORATION
1414 Chestnut Avenue
Hillside 5, New Jersey

Washington Roundup

CAA Deputy Post Out

Talk of appointing a deputy civil aeronautics administrator has been squelched by Administrator Fred B. Lee. He told AVIATION WEEK last week he never intended appointing a deputy. No such job exists, Lee said, since the post has been "abolished" and the duties "disseminated" in CAA's economy drive. Before assuming his present post, Lee was deputy to Charles F. Horne.

Civil Service Commission last fall granted a Commerce Department request that the deputy administrator post be removed from Civil Service status and made a policy appointment (AVIATION WEEK Nov. 23, p. 15). At the same time, CSC authorized that five other CAA posts be made policy appointments: general counsel, confidential assistant to the administrator, and private secretaries to the administrator, deputy administrator and general counsel.

ACC Assigns Responsibility

Air Coordinating Committee, seeking to obtain positive, realistic recommendations for its air policy review, has voted to assign individual agencies the responsibility for carrying out each recommendation.

ACC feels that this action will keep to a minimum the broad generalities that have characterized previous policy reviews by considering them in the light of practical administration. The recommendations and agency implementation assignments, if approved by the President, may have the force of law through executive order powers.

International Airline Showdown?

Observers are wondering whether international air carriers will carry their controversies up to the Senate Commerce Committee for public debate when hearings open on the McCarran bill next week. If they do, there could be serious repurcussions. Senate Appropriations Committee will be considering money for airline subsidies while the hearings are going on. Before World War II, this group struck out money for mail pay for American Export Airlines, certificated to fly the Atlantic in competition with Pan American Airways.

Hoover Commission Studies

Commission on Organization of the Executive Branch of Government is studying two areas of vital concern to the aviation industry:

- A special task force on "admission to practice before government agencies" is expected to consider the question of whether former Civil Aeronautics Board officials should be permitted to represent airlines or other interested parties in cases before the Board after leaving their government posts. The three-member force includes former CAB chairman James Landis, now a Washington attorney.
- A 10-member task force has been appointed on "government procurement methods" and directed to put special emphasis on defense procurement methods, including inspection on contract performance, changes in contracts, financing of contracts and pricing. Headed by Robert Wolcott, board chairman of Lukens Steel Co., the force includes Mundy Peale, president of Republic Aviation Corp.

States-Alaska Problems

The "States-Alaska case," currently being heard by CAB's chief examiner Francis W. Brown, will be the first major trial of two conflicting policies within CAB membership and the Administration.

Conflicts:

- Should the Seattle-Alaska operators absorb the local intra-Alaskan lines? or
- Should the trunk and local be kept separate?

The Administration is anxious to cut subsidy costs, but CAB is desirous of keeping feeder airlines separate from the trunks on the domestic scene.

More Long Blasts

Sen. Russell Long says his recent criticism of Civil Aeronautics Board for its quick decision granting authority to American Airlines for direct New York-Mexico City service is not his last. The Louisiana senator plans to attack CAB on another score: for not allowing Post Office Department to dispatch mail by the certificated all-freight carriers.

DME 'Tempest'

CAA's decision to complete installation this year of 327 civil DME (distance measuring equipment) stations has stirred up what CAA officials call a "tempest in a teapot" in the industry. CAA boss Fred B. Lee says the policy is "our idea and we will stick by it" (See story page 18).

From Navy to USAF

H. Lee White, a Naval Reserve commander when he took over as Assistant Secretary of the Air Force last year, has quietly had his commission changed. He is now an Air Force Reserve colonel. He served in the Navy from 1943 to 1946.

Although it was the subject of some quipping, White's situation is not without some precedent. Navy's former Secretary Dan Kimball, well liked by the admirals, served as a flier in the U. S. Air Service, predecessor of USAF, in World War I.

Lindbergh Reward

Nomination of Charles A. Lindbergh to be a brigadier general in the U. S. Air Force Reserve is regarded as a well-deserved reward for his services to military airpower during World War II and the postwar period. Lindbergh's wartime service in developing high-altitude capabilities of the P-47, stretching the range of the P-38 and proving the dive-bombing ability of the F4U have been well told by his close friend Lauren D. "Deac" Lyman, vice president of United Aircraft Corp. But few people know of his postwar work for the Air Force in developing high-altitude capabilities of the B-36 bomber and other technical work still secret. Lindbergh shot down two Japanese fighters in the Pacific while flying P-38s as a civilian technical representative of the United Aircraft organization.

—Washington staff

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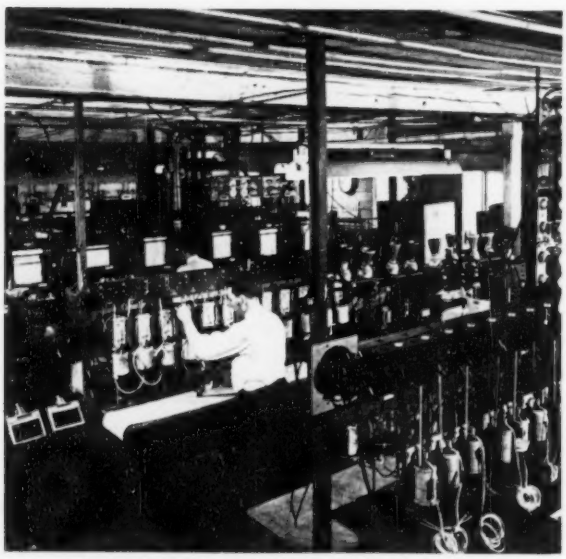
2. WORLD'S FASTEST PISTON-POWERED AIRLINER, the Douglas DC-7, combines top speed with maximum safety and passenger comfort. As in Douglas-built planes for many years, beginning with the DC-4, Fenwal THERMOSWITCH® Heater Controls maintain steady, comfortable warmth in the cabins for passengers and crew.



3. THE HIGH ACCURACY OF FENWAL PRODUCTS is assured by thorough testing and inspection in this modern quality control laboratory. Supplying the aircraft industry's constantly increasing demands for THERMOSWITCH® temperature control and detection devices, Fenwal mass-produces these units in types covering widely varying applications.

4. CUTAWAY VIEWS of Fenwal Over-Heat Detector (left) and Heater Control. The shell is the temperature-sensitive element that expands or contracts instantly with temperature changes, making or breaking the contacts. Fenwal units are compact, highly resistant to shock, vibration and extreme temperature changes. For complete data, write to **Fenwal Incorporated, 229 Pleasant Street, Ashland, Mass.**

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WHO'S WHERE

In the Front Office

Robert E. Peach, former executive vice president and general manager of Mohawk Airlines, is new president and a director of the local service air carrier. He succeeds **E. Victor Underwood**, who has been elected board chairman.

W. W. White has taken a leave of absence as a vice president, director and general manager of Esso Export Corp.'s aviation department, New York, to accept an extended USAF assignment as staff director for petroleum logistics with the Defense Department in Washington, D. C.

Brig. Gen. Joseph T. Morris (USAF Ret.) is a new vice president of United Aircraft Products, Dayton, Ohio.

Don L. Walter has been elected vice president-operations of Marquardt Aircraft Co., Van Nuys, Calif.; **William H. Schwebel** is new vice president-finance.

Earl W. Snyder has become director of aeronautics for the state of Oregon, succeeding **W. M. Bartlett**, who resigned.

C. E. Willis has been elected vice president and general manager of National Water Lift Co., aircraft components producer at Kalamazoo, Mich. Other changes: **T. Harada**, vice president and works manager; **Carl A. Peterson**, treasurer and controller; **Norman C. Bryan**, sales and contracts manager; **C. O. Weisenbach**, engineering manager.

Changes

Ben Lee, former military editor and more recently assigned to industry relations for AVIATION WEEK, has joined the staff of the McGraw-Hill Washington News Bureau.

Dr. H. K. Skramstad has been promoted to director of Missile Systems Division at the Naval Ordnance Laboratory, Corona, Calif. **G. R. Sams** is new director of Missile Evaluation Division.

Warren H. Franks has become manager of Voi-Shan Manufacturing Co.'s new Industrial Division. **A. Pra** has been appointed quality manager.

Edward T. Martin has become superintendent of training for Flight Safety Inc., New York.

Honors and Elections

Edwin A. Link, president of Link Aviation, Binghamton, N. Y., has received USAF's Exceptional Service Award for outstanding contribution to the defense effort.

LeRoy Lampson, onetime president of Agricultural Aircraft Assn., has been appointed a member of the California State Aeronautics Commission.

Francis A. Arcier has been presented USAF's Meritorius Civilian Service Award for "outstanding performance of duty" as scientific advisor at Air Technical Intelligence Center, Wright-Patterson AFB, Ohio.

James P. Barbour, manager of aircraft sales for Westinghouse Electric Corp.'s Small Motor Division, and **Bascum O. Austin**, manager of the aviation engineering department's control section, have been awarded the Westinghouse Order of Merit.

INDUSTRY OBSERVER

► Lockheed's XFL prototype of its vertical-takeoff interceptor has flown horizontally at Edwards AFB. Pilot was Herman "Fish" Salmon.

► **Army is planning to purchase the Sikorsky H-37 for cargo and troop transport use. Production at Sikorsky's new Stratford, Conn., plant will be split with the Marine Corps.**

► Italy's first production model of the F-86K is scheduled to come off the line at Fiat's Turin plant in six months. The North American Sabres are being produced under the Joint Aircraft Program for NATO use.

► **Exercise Sky Drop II, scheduled to be held at Fort Bragg, N. C., during June, is planned to evaluate the efficiency and capabilities of rotary- vs. fixed-wing aircraft for specific Army jobs.**

► Ryan Aeronautical Corp. has signed a 57-million contract with USAF for extensive research and development work of a "highly confidential nature." Ryan's financial report this week revealed that work is under way on pilotless jet airplane contracts.

► **Mine detectors have been installed in the perimeter taxiways at London Airport so the control tower can "spot" airplanes under conditions of poor visibility. Plane taxies over the detector, lighting a position indicator in the control tower.**

► What promises to be the most extensive application of reinforced plastics in any airplane configuration is a prototype low-cost, personal-type Cessna Aircraft Co. is working on at Wichita, Kan. Embodying fibrous glass-reinforced plastics in about 70% of its makeup, plane also will have potential use as small military liaison type.

► **In anticipation of the coming expansion in helicopter transport, training schools will soon prepare to make copter flight and maintenance training major parts of their operations.**

► Industry observers are not putting any limit on the size or performance of future rotary-wing aircraft. They point out that there were many who said a wing the size of that on the B-36 or one with the flexibility of those on our later bomber airfoils couldn't be engineered soundly.

► **Grumman Aircraft Engineering Corp. this month will complete delivery of the SA-16 Albatross order to USAF. Approximately 300 of the twin-engine rescue and amphibian aircraft will have been manufactured for Air Force use.**

► USAF reports it has furnished Philco Corp. with sufficient data on the Hughes Aircraft Falcon air-to-air missile for "educational" purposes. USAF says it has no definite plans now to bring Philco into the Falcon production picture as a second source of supply. Falcon now is being built at Hughes' Tucson, Ariz., plant.

► **Pan American World Airways reportedly will be the first commercial airline to evaluate the optimum speed indicator, product of Safe Flight Instrument Corp. (Aviation Week May 25, 1953, p. 67). PAA has currently installed one instrument on a DC-6B for evaluation purposes. Instrument is undergoing calibration, and flight tests will begin soon.**

► Atomic Energy Commission reports that test facilities for an atomic aircraft reactor are being built at the National Reactor Testing Station, Arco, Idaho.

► **North American Aviation, Inc., is the major AEC contractor exploring sodium-graphite reactors. This type of reactor is cooled by liquid metal sodium and moderated by graphite. It requires slightly enriched uranium fuel.**

► When current helicopter production contracts are completed, Army will be the largest rotary-wing operator. Army has 1,000 helicopters in service or on order; Navy about 650, and USAF 350.

AVIATION WEEK VOL. 60, NO. 8
FEBRUARY 22, 1954

ARDC Shuffles Weapons Systems Pattern

- **Development planning and procurement to be shifted from Dayton to Baltimore, later to Andrews Field.**
- **New operation will be an industrial-type organization to facilitate dealings with aircraft and parts builders.**

By Robert Hotz

Focal point for Air Force planning and procurement of weapons system development will shift soon from Dayton to Baltimore and eventually to Andrews Field, Md.

This is what the new reorganization of the Air Research and Development Command headquarters means to the aircraft industry. The headquarters shift was implemented last week by Lieut. Gen. Donald L. Putt, ARDC commander. It is coupled with plans to shift ARDC headquarters from its present location in downtown Baltimore office buildings to a new structure to be built at Andrews Field.

▶ **Industry Effects**—Here are the major points in the ARDC reorganization that will affect the aircraft industry:

- **Weapons system development** planning and procurement will shift from Wright Air Development Center to ARDC headquarters.
- **ARDC headquarters** will be modified from a standard military-type organization in the direction of an industrial-type organization to facilitate dealings with the aircraft industry.
- **Weapons system project** officers and key personnel from ARDC headquarters will be assigned to specific systems throughout their development and production cycle to insure technical continuity and facilitate closer liaison with industry technical teams.
- **Guided missiles office** will be established in ARDC headquarters to coordinate all USAF development activity in this field. Col. H. J. Halberstadt will head this office.
- **Atomic energy office** will be established in ARDC headquarters, reporting directly to General Putt. This office will be headed by Col. William D'Ettore and will be concerned primarily with developing USAF capabilities with thermo-nuclear weapons in addition to nuclear propulsion for aircraft and other atomic energy applications of interest to USAF.
- **Directorate of Research** will be established, headed by Col. Don Flickinger. This will include the present Office of Scientific Research under Lt. Col. William O. Davis, plus Geophysics Division, headed by Lt. Col. R. F. Long, and the Bio-Sciences Division (formerly human factors), headed by Col. J. M. Talbot.

▶ **Centralizes Authority**—Gen. Putt told AVIATION WEEK the reorganization was the result of a four-month survey of ARDC problems and was a significant step in the evolution of the command toward the most efficient and effective methods to fulfill its research and development mission.

"We are centralizing responsibility and authority for new weapons systems in a more streamlined organization to make the most effective use of the limited number of experienced and senior technical personnel available to the Air Force," he said. "We are tailoring ARDC into a more industrial type of organization to do the research and development job and super-imposing a minimum of the military-type organization necessary because we are a military command."

Biggest news to the aircraft industry is the shift in weapons system planning and procurement from Wright Air Development Center to ARDC headquarters.

For background on how the weapons system development was handled under the former system see AVIATION WEEK (Aug. 17, 1953, p. 81).

Under the new plan, the Directorate of Weapons Systems in ARDC headquarters will handle all weapons systems planning from the time the general operations requirement is received from USAF headquarters through preparation of general design studies and the approval of a system development plan by USAF headquarters. Col. Ernest Lunggren heads the Weapons System Directorate in ARDC headquarters.

▶ **ARDC to Assign**—The Directorate of Weapons Systems will also break up the general operations requirement into supporting systems and component development programs required for the overall weapons system and assign portions of this job to the technical directorates in ARDC headquarters and the ARDC centers. In the future the technical laboratories at Wright Field will get their assignments from ARDC headquarters instead of directly from WADC.

Selection of a contractor to develop the weapons system and contract negotiations for this development will be handled by the ARDC headquarters procurement directorate headed by Col. J. R. "Bob" Martin.

▶ **WADC Monitoring**—After the development program has been planned, approved and contracted for by ARDC headquarters it will be turned over to the Weapons Systems Office (formerly directorate) at Wright Air Development Center for implementation. Thus the focal point for industry during the planning, competitive design study and development procurement stage will be ARDC headquarters. During the actual development cycle, focal point will be the joint project offices in the weapons system office at WADC.

ARDC feels that actual development should be monitored by the JPO at WADC because of the necessity for daily contact with both the WADC technical laboratories and Air Materiel Command on technical and procurement problems.

▶ **Personnel Transfer**—However, ARDC plans to get a better continuity of its effort on systems development by physically transferring the system project officer and a few key personnel on any specific system from the Weapons System Directorate in ARDC headquarters to the JPO at WADC when the system shifts from the planning to the development phase.

Thus it will be possible to have a small, key group of military personnel monitor a system development from inception to large-scale production and paralleling the industrial technical teams with whom they will work.

Many of the senior technical civilian personnel now working in the WADC Weapons System Office will be transferred to ARDC headquarters where they will be used in the new systems planning and development program.

It is evident that the ARDC reorganization, particularly as it affects weapons systems development, was aimed at meeting specific industry objections to the former planning, development and procurement methods.

Congress Gets Red Plane Facts

Aviation Week photos cause stir in official Washington; Symington says they prove Defense underrates Russia.

Publication by AVIATION WEEK of the first photographs and technical data on the capabilities of two new Russian intercontinental bombers stirred official Washington last week.

Reactions included:

• **USAF intelligence experts** were studying negatives of the AVIATION WEEK photos of the Il-38 and Tu-200 bombers, as well as other data provided by this magazine on USAF request. Prints of the two Russian bomber photographs were shown to intelligence experts in USAF headquarters by AVIATION WEEK before publication.

• **Sen. Stuart Symington** former USAF Secretary, cited the AVIATION WEEK photos and data on the Il-38 and Tu-200 as evidence that the Defense Department was continuing to underestimate Russia's capability to deliver atomic air attacks on the United States. Symington's charges were made in a speech on the Senate floor.

• **Defense Secretary** Charles E. Wilson canceled his weekly press conference and was not available for comment on either the AVIATION WEEK photos or Symington's charges. Wilson was reported vacationing in Miami.

▶ **Text of Speech**—Following is the text of Sen. Symington's Senate speech:

"Mr. President, prior to reaching an opinion on the new-look military budget, I have been attempting to analyze the figures in that budget and the reasoning behind them.

"If the photographs in the current issue of AVIATION WEEK, an outstanding McGraw-Hill publication, are correct—and I am assured that they are correct—then it is obvious that what some of us have feared for a long time has come to pass, namely, the Soviets are making further inroads on the air superiority of the United States in this air-atomic age.

"We may have more nuclear bombs than they, but no one needs an excess number of rifles to destroy an enemy.

"The first of these photographs, the article says, shows the Ilyushin-38, a modern swept-back-wing unit with four turboprop engines—a class we do not have. Its size, according to experts, would appear to be somewhere between that of our B-47 and B-52—that is, somewhere between medium range and long range.

"The second photograph shows the Tupolev-200, a new and very long-range, swept-back-wing bomber driven by six turboprop engines. This bomber is of a weight and general performance comparable to our B-36, but far more modern. The article points out that the Tupolev-200 has great speed, atomic capacity, and intercontinental range.

▶ **Old Look?**—"If this information is correct, I respectfully ask my colleagues to give full consideration to just what these disclosures mean to the security of the United States today and in the immediate future. Could it be that the Soviets already have had a new look for so long a time that to them it is now an old look—in any case a new look in being?

"The article reports that the latter bomber is in squadron service in northern Russia, right across the Polar Cap from North America. If this be true, then the Soviet position from the standpoint of a combination of performance coordinated with atomic potential may be superior to ours, because we have not a single modern long-range bomber wing in action.

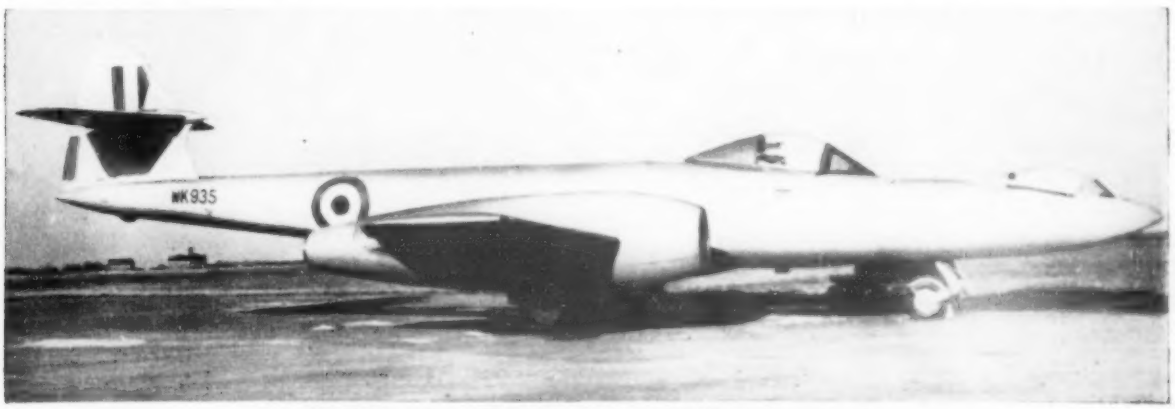
"Note that both these new bombers, according to the experts have radar bombsights.

"Just prior to World War II, America had no knowledge of the possession of thousands of Zero fighters by the Japanese. The refusal to recognize the production ability as well as the engineering capacity of our enemy cost this country billions of dollars in treasure, plus many thousands of American lives.

▶ **Past Experience**—"Some years ago, when, as Secretary of the Air Force, I presented to higher authority photographs of the new MiG-15, I was told the Soviets were not capable of producing such a plane, and that probably the pictures were 'faked.' When we entered Korea and were greeted by hundreds of the at-that-time world's best fighter, the MiG-15, again it was obvious that we had underestimated both the production capability and engineering genius of our enemy—and this, too, cost us heavily in treasure and blood.

"On May 20 last, at the time when some were bitterly protesting against the $5-billion Air Force cut, in a hearing before the Senate Subcommittee on Military Appropriations, the Department of Defense asserted that the United States had more long-range bombers than Soviet Russia; also it was stated that there were indications that the Soviet was concentrating on fighter planes and defensive craft. The Secretary of Defense added, 'I think our people can take some comfort in that.'

"If the news story about the new bombers is correct, where is the comfort? On the contrary, we may now be looking down the barrel of a possible intercontinental attack.



British Jet Tests Prone Pilot Layout

This modified Armstrong Whitworth Meteor fighter, fitted with a prone pilot position in the nose, is being used by the firm to conduct research into this type of layout. A conventional cockpit is located behind the prone position. Armstrong Whitworth has released no further details on the aircraft, which first flew Feb. 10, or the test program on which the Meteor fighter is being used.

"Last Sept. 29 the Secretary of Defense stated:

"'**The Russians' best bomber is an improved version of the B-29.**'

"And on Oct. 6 he added:

"'**It will take the Russians at least three years to get either the aircraft or a droppable bomb to deliver a hydrogen attack on the United States.**'

"He further stated:

"'**We give the Russians credit for having aircraft that they just don't have.**'

"If the story and the photographs to which I have referred are correct, how can one justify such statements?

"Many persons believe the Soviets are ahead of us in the development of the hydrogen bomb. I do not know about that, but I do know that any statement made by the department to the effect, 'It will take the Russians at least three years to get the aircraft to deliver an attack on the United States,' was incorrect even before these photographs were published.

▶ **Fatal Mistake**—"If America makes another mistake—this time in underestimating Soviet engineering and production ability with respect to long-range bombers, as we already have done with respect to fighters—it could well be the last mistake we shall ever be allowed to make.

"A 'new look' should be a two-way look. It should look inward with respect to our economic development and national military power. It should look outward so as to fix the nature of the power of a possible enemy.

"Again I plead that the Administration frankly give the Congress and the American people all truth about the strength of our possible enemy which will not help that enemy in its development of plans and weapons necessary to accomplish its oft-announced intention to destroy the free world."

Canada Builds New Early Warning Radar

Toronto—Royal Canadian Air Force is building a low-cost radar network to supplement the joint U. S.-Canadian early warning system.

Details of the new radar, developed by McGill University at Montreal, are classified as secret by the military. It is known, however, that the "McGill Fence" is less expensive to build and to operate than conventional radar stations but is not as effective as regular screens.

Location of the new screen also is secret, other than that it is not being constructed in the far north.

Canadian Defense Research Board at Ottawa thoroughly tested the radar screen before it was turned over to RCAF.

Jet Evaluation

- **CAA says U. S. airlines will fly turbines by '58.**
- **Study lists preparatory steps for start of service.**

American turbine-powered transports should be flying the nation's airplanes within the next three to five years, Civil Aeronautics Administration predicts.

The forecast is made in the year-long study by CAA's turbine-powered transport evaluation team, headed by George W. Haldeman, special assistant to A. S. Koch, director of CAA's Office of Aviation Safety.

▶ **Domestic Service First**—Turbojet and turboprop transports will be flying domestically before they are used in international service, the study says, and civil cargo flights may precede passenger operation.

The survey cites two principal developments that will speed introduction of jet airliners in the U. S.:

- **Accent on speed** brought about by Douglas DC-7s and Lockheed Super Constellations, both powered by Wright Turbo Compounds.
- **Impact** of British turbine-powered transports.

The report was compiled after a year of study in jet transport research, design, test and operating problems with manufacturers, operators, military and research agencies in the U.S. and abroad.

Members of the CAA team: Harold D. Hoekstra, Robert J. Auburn, Robert V. Ford, Robert F. Gates and Burdell L. Springer.

▶ **Recommendations**—In summing up its findings, the transport team makes these recommendations:

- CAA should obtain experience with several civil turbine transport designs, while developing policy rulings from which specific Civil Air Regulations may be proposed as experience indicates.
- Thorough testing, including simulated airline service and carriage of cargo, should be done prior to use of jet airliners in scheduled passenger operation.
- Key CAA engineers, pilots, maintenance and operations personnel should be given special and continuing training and education to prepare for certification and operation problems in the near future.
- Close coordination should be maintained among representatives of airframe manufacturers, powerplant manufacturers, airline operators and CAA in development of turbine engine installations in the new transports.
- Close liaison should be established among CAA, the military, research organizations, and the industry to obtain, correlate, exchange and study information gained from operation and maintenance experience.
- National Advisory Committee for Aeronautics should accelerate and extend its VGH (speed-acceleration-altitude measurement) and other related programs in cooperation with airlines and military services to obtain well-instrumented data and statistics in operation, particularly for flight, structural and powerplant purposes.
- NACA should study the overall problem of ditching and off-airport landings because of the substantial differences from present transports that will be introduced by the use of pods and other unusual engine locations.
- Additional study should be conducted on the possible development and use of the bypass or ducted-fan engine principle.
- Research should be conducted on means of improving tire-to-runway friction under adverse conditions.

▶ **Airline Service**—The study predicts turboprop and turbojet transports may come into service at about the same time.

The turboprop is viewed as becoming an important factor in aircoach, cargo and possibly in local service and executive aircraft operation because of its lower direct operating costs.

The bypass or ducted-fan engine, "a type of turbine powerplant intermediate between the turbojet and the turboprop," may have promise in the high-speed transport field, the team says, "because of its potential advantages in low specific fuel consumption and reduced noise."

▶ **Development**—Problems to be coped with in the development of turbine-powered transports, the evaluation team finds, are:

- Structural designs strong enough to meet the faster speeds with satisfactory comfort for the passenger, while completely maneuverable with adequate margins against fatigue failures.
- Reliable pressurization for operation at higher altitudes.
- Control systems with feel characteristics as good as present transports.
- Configurations and location of powerplants providing maximum insurance against "catastrophic damage" from engine failure.
- Engine designs incorporating careful provision against contamination of the air taken directly from the compressor for cabin pressurization.
- Applying lessons learned from past propeller-reversing problems and best features of "fail-safe" design to turboprop propeller and power controls.

There is considerable optimism that a practical device, which provides about

40% thrust in reverse without appreciable penalty in normal operation, will be developed in time for use in the first civil jet transport operation in the United States.

- Probable use of water for thrust augmentation. It is likely that 20% of afterburning may be used for certain longhaul operations, but noise and appearance of flame "will militate against it."
- Preventing adverse effects in operation and in maintenance, probably through a closely controlled uniform grade of fuel. Cost and space advantages of a kerosene-base fuel will justify its use in the transports over a gasoline-base fuel.
- Substantial improvements in electrical equipment and possible isolation from the pressurized cabin for the higher-speed, higher-altitude turbine-powered aircraft.
- Many controls, components and details, such as ground inspection doors and drag devices, become of primary importance.
- Further work on brakes or other decelerating devices.

Because of high purchase and operating costs of the equipment, as well as operational unknowns, test programs leading to the integration of turbine aircraft into airline operating fleets will require thorough planning, the survey warns.

Despite earlier reports to the contrary, the CAA team has found that turbine transports will be able to operate from present-size airports "except for such continuing improvements and gradual increases in length as may evolve."

No substantial change in present CAA airport standards is anticipated by the evaluation team.

► **No. Runway Limitation**—Turboprop aircraft probably will not be limited by takeoff runway distance, the report indicates.

The jet transports are being designed to operate over present routes from present airports.

A check of designers has brought these figures:

In domestic operation, a 6,400-ft. takeoff runway length will be required for a 2,000-mi. flight.

Transocean operation will require 8,400-ft. takeoff runway lengths for flights of 3,000 mi. or more.

Development of special new loading ramps and passenger loading busses is foreseen because of the noise and blast effects of turbine-powered aircraft. New methods of traffic separation at high altitudes probably will be necessary, the report says.

Present VOR, DME and ILS systems "should prove to be adequate for turbine-powered aircraft and terminal operations."

AA Loses First Court Fight for Mexico Route

American Airlines' proposed nonstop service between New York and Mexico City will be delayed indefinitely.

Three judges of the Circuit Court of Appeals in the District of Columbia have ruled in favor of Eastern Air Lines and Pan American World Airways' petitions to prohibit inauguration of American's new service, holding it would damage EAL and PAA business in the Southwest (AVIATION WEEK Feb. 15, p. 88).

The case will be reviewed by the court after Eastern and Pan American file briefs detailing their cases within the next month. Civil Aeronautics Board, which approved the service, has 25 days after the airlines have filed their briefs to file an answer.

CAB exempted American in a three-two decision so that the airline could begin nonstop Mexican service. Now that the court has ruled in favor of the Eastern-PAA stay, the Board's exemption decision will be reviewed in detail.

Indications are the case will be speeded up in order to come within the current court schedule, which ends June 30.

ODM Spurs Titanium, Airport Expansion

Office of Defense Mobilization is offering the incentive of rapid tax amortization to spur construction of airport facilities and titanium processing facilities.

ODM set an expansion goal of 37,500 tons a year by 1956 for titanium processing facilities. Current capacity is 7,680 tons a year, and expansion to 11,800 tons a year by 1956 has been programmed. Facilities to increase this capacity to 37,500 tons will be eligible for tax benefits.

An open-end goal was set for expansion of airports. Such facilities as hangars for major overhaul, modifications and repair, storage of aircraft and parts, and other terminal facilities are eligible for rapid tax amortization benefits.

ODM also put facilities for military aircraft back on the list of eligibility for tax benefits. In December, military aircraft facilities were suspended from the list, pending a review to determine whether expansion was sufficient for American defense requirements.

USAF Grounds H-21s After Third Crash

USAF grounded its fleet of about 30 H-21s last week following the crash of one of the Piasecki helicopters near Trois Pistoles, Quebec. Two Air Force officers and Piasecki field representative William Blenkin were killed in the accident.

The aircraft was en route to Goose Bay, Labrador, for duty with the Northeast Air Command. Piasecki service manager Thomas Pierpoint left immediately for the crash scene to assist in the investigation.

Quebec crash was the third for the H-21, and USAF's decision to ground the copter followed quickly. First crash occurred in Greenland Nov. 17, 1953, and another broke in two Dec. 23, 1953, while undergoing dive and pullout tests in Pennsylvania (AVIATION WEEK Jan. 4, p 15).

Deliveries of the H-21 to operational units started late in 1953 and the Air Force had been putting them through operational suitability tests, particularly to determine capabilities of the craft in Arctic rescue work.

USAF and Army orders for the H-21 Work Horse will keep Piasecki's Morton, Pa., plant running through 1955. RCAF has ordered six H-21s.

Douglas Delivers 21 Skyraiders in One Day

Some of the 21 Douglas AD-6 Skyraiders recently delivered in one day to the Navy by Douglas Aircraft Co.'s El Segundo Division are seen on the ramp prior to flyaway. This delivery marked the largest single turnover in planes in one day to the military since the end of World War II, according to a spokesman for the aircraft builder.

Why Executives Like Their Planes

Despite certain drawbacks and the high cost of operating business aircraft, most companies using them are pleased with the results and would hesitate to eliminate them.

This is the basic theme of a special report on "Managing Company Airplanes," released by the National Industrial Conference Board last week, in which predictions were made for continued growth of the business flying field.

NICB attributes the tremendous increase in number of U. S. companies taking to the air in their own planes to several factors:

• **As a result** of the rise in commercial air travel during World War II, many executives came to appreciate the airplane's advantages.

• **After the war,** a large number of surplus aircraft were made available at very low prices.

• **Current tax structures** have made acquisition and operation of a private plane attractive to many companies that previously might have been deterred by the relatively high cost of purchasing and operating such a plane.

Combined, says NICB, these factors have produced a four-fold increase in company ownership of airplane's since the end of World War II. The board repeats the popular claim that currently, counting single-engine planes, there are approximately 10,000 such aircraft in operation.

▶ **Other Advantages**—Citing additional advantages of business flying, NICB points out that the private plane combines the speed of commercial air travel with much of the flexibility of automotive travel. Further, says the board:

• It provides complete flexibility in departure or arrival time and offers many times the choice of destination that is possible by commercial air travel.

• It also eliminates the time-consuming dog-legs and transfers that often make commercial air travel between outlying towns inefficient.

This management tool is viewed as a mixed blessing by most company executives, NICB points out. On the credit side, company airplanes ease the wear and tear that executives experience from extensive travel.

▶ **Ad Medium**—The company plane also offers a retreat from the noise and distraction of commercial travel and permits the conduct of important business en route.

NICB adds that it cannot be overlooked as a good advertising medium as well as an excellent means of entertaining important clients.

One company points out in the report that in this age of high-pressure operation and high executive mortality, the company makes it possible for an executive to get far away from his desk for brief respites—thus increasing his effectiveness and his value to the company and the nation.

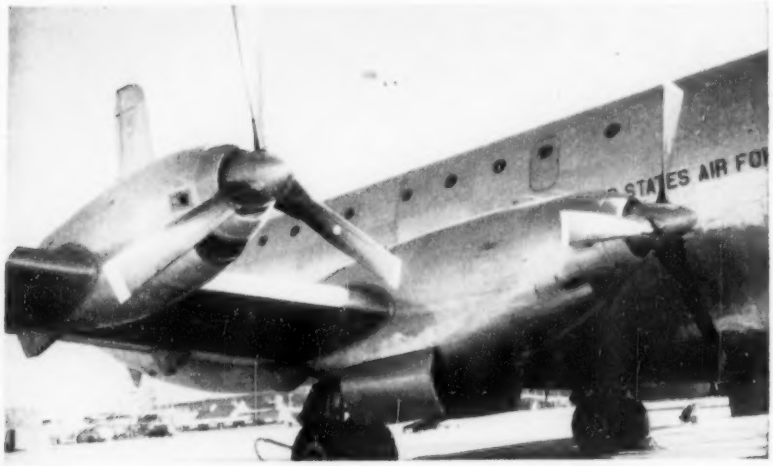
But some executives take a dim view of the company plane, NICB finds, not because of any reservations about air travel, but because it puts more strain on them.

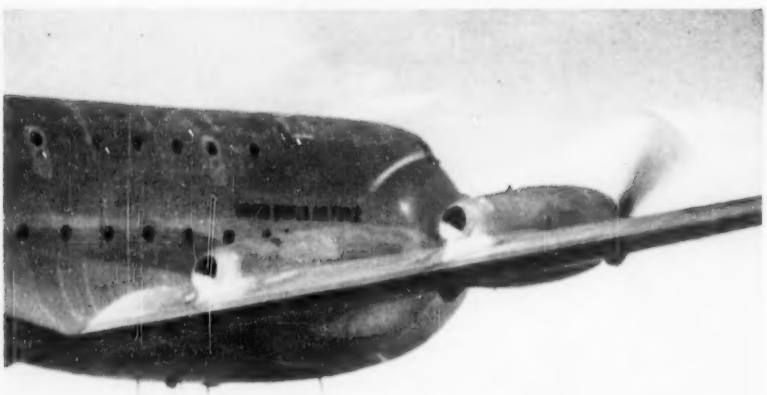
▶ **Dissenter**—The report quotes one such executive: "Thanks to the acquisition of our airplane, I now have to wrestle with twice the number of problems I did formerly. A lot of these problems used to be solved because I couldn't get there in time to be of help, or our plant managers didn't want to ask me to make such a long trip to help them.

"But now they nonchalantly ask me to jump in the plane and fly out, or else they pop up at my desk with their problems—having just flown over for lunch."

Such thinking does not represent the majority of executives, however, says NICB—emphasizing that the findings would seem to indicate that business flying is here to stay.

▶ **Two Groups**—The board's report was undertaken as part of a continuing series of studies in business policy. It was prepared by Leonard R. Burgess and Malcolm C. Neuhoff, members of





Closeup Look at C-124 Turboprop Engines

Installation of Allison 5,500-eshp. turbo-props in Douglas YC-124B is detailed in closeup views showing front of powerplants (top picture) and tailpipes (lower photo). Props are three-bladed Aeroproducts with square tips and de-icers on leading edges. YC-124B Globemaster recently flew from Douglas plant at Long Beach, Calif., to Edwards AFB (Aviation Week Feb. 15, p. 7) for further tests.

NICB's Division of Business Practices.

Main purpose of the study was to assist two groups of U.S. companies:

- Those considering purchase of an aircraft for executive use.
- Those that currently are operating planes but would like to compare their aircraft operations with those of other companies.

Taking sample companies, the analysis shows the types of airplanes being used, cost of operating them, source of pilots and how they are chosen and trained, and the rules which govern use of aircraft in a representative cross section of U.S. business firms.

► **Cost Comparison**—In its analysis, NICB breaks down operating costs and compares them by aircraft types for 1952.

Items considered in each operation are:

- Salaries, wages and employe benefits for all aircraft personnel.
- Gasoline and oil.
- Maintenance, materials and supplies.
- Depreciation.
- Other expenses, including hangar rental, landing fees, administrative costs.

Complete copies of the study are available only to companies associated with the National Industrial Conference Board, although exceptions will be made for educational institutions and government agencies.

Build Pilot Reserve, ICAO Chief Warns

Ottawa — Western governments should follow Canada's lead in sponsoring flying clubs and schools to counterbalance Russia's "immense reserve" of lightplane and glider pilots, warns Sir William P. Hildred, director general of International Air Transport Assn.

"Flying in Russia is a strictly nationalized sport and I am told that you have to have the qualifications of a first-class soldier before they will bother about you," he reports.

"The Peoples Civil Flying Organization there is on a scale far exceeding anything else in the world."

Hildred says Canada's scheme, combining individual initiative with government aid, produced 1,000 private and 150 commercial pilots during 1953.

Titanium Price Cut

Titanium Metals Corp. has reduced the price of processed titanium 12%, a cut that will apply to present orders for $2 million in commercially pure sheet and plate and all future purchases.

The firm has not yet perfected and put into production an alloy sheet product, the primary requirement for highspeed aircraft and guided missiles.

PAA Wins Missile Base Contract

Airline will operate ARDC's test center at Patrick AFB, Fla.; RCA is subcontractor for electronic facilities.

By Frank Shea, Jr.

Pan American World Airways will take over operation of the Air Force Missile Test Center at Patrick AFB, Cocoa, Fla., under terms of a contract awarded by Air Research and Development Command. Radio Corp. of America will act as subcontractor.

Signing of the agreement concludes more than six months of negotiations, and confirms earlier AVIATION WEEK reports that such a plan would be put into effect (July 27, 1953, p. 10; Feb. 1, p. 11).

► **Contract Operation**—Air Force decided on contractor operation of the missile range for two reasons:

- The missile test program has been retarded seriously by lack of adequate technicians to man the down-range, data-gathering stations.
- Economy.

Early last year, 12 organizations submitted proposals for operation of the range, in accordance with ARDC requests. Each was asked to define the extent of the work to be done, as well as estimate the cost. The joint proposal of PAA and RCA was judged the most practical and received Air Force's nod last July. Negotiations began at that time.

Terms of the final contract have not been revealed. But indications are that the operation will be much the same as that of Aro, Inc., at Arnold Engineering Development Center, Tullahoma, Tenn., with Pan American responsible for over-all operation of the range and RCA handling the electronic facilities.

► **1,000-Mi. Range**—AFMTC is a potentially valuable laboratory, not only for testing of long-range Air Force missiles but for those of other agencies as well. Beginning at the Cape Canaveral launching site, it has a range that extends 1,000 nautical mi. through the Bahama Islands to Puerto Rico.

Through this area, USAF maintains five down-range stations on the islands of Grand Bahama, Eluethera, San Salvador, Grand Turk and Mayaguana—each with its own communications center and telemetry receiving station for purposes of recording missile performance data. Two additional stations are planned for the Dominican Republic and Puerto Rico.

ARDC indicates that Pan American's extensive knowledge of this area was an important consideration in awarding of the contract.

► **Projected Plans**—PAA's technical and route-planning experience also will come in handy should Air Force decide to go ahead with projected plans for extension of the range. It is expected that the 1,000-mi. mark will be greatly increased as longer-range missile requirements demand it.

If the range were extended along its present path from Cape Canaveral down the chain between the Dominican Republic and Puerto Rico, the flight line could be continued to cut across the northeast corner of Brazil. From there the next landfall is the southern tip of Africa.

Brazil would seem to be a practical terminus for the range for some time to come; an impact area there would be about 3,500 mi. from the launch point. If the missile could be turned there and flown back, 7,000 mi. is the obvious range distance.

► **Technical Outposts**—Pan American and RCA personnel will run the down-range stations, or technical outposts as they sometimes are called, with each installation manned by 100 to 150 hand-picked technicians.

A typical installation will find these groups handling complete radio and wire communications, a weather station, range safety center, telemetry receiving station, radar and optical tracking center, an airstrip and living quarters for personnel.

Indications are that the airline also will handle maintenance and servicing of all facilities at the Cape Canaveral launching site, as well as all ferrying operations involving transfer of personnel and supplies to and from down-range stations.

Presently, small supplies needed for operation of these stations are flown in by Fairchild C-119s. Bulk supplies are sent down in the holds of landing craft.

► **Testing the "Birds"**—Big part of the PAA-RCA operation will be a close working relationship with various missile contractors.

Like most other development test centers of ARDC, contractor service is a major responsibility at AFMTC. A large share of this responsibility will be turned over to the PAA-RCA team.

Purpose of the range and supporting services is to help a missile contractor get the kind of data he wants.

As in other centers, the contractor is the boss; his tests can cover any reasonable ground, and he can ask for—and get—any reasonable support he needs. When his test is finished, PAA and RCA will furnish him all pertinent data in a package.

► **Range Safety**—Safety of the range is

the only consideration that can overrule a contractor's wishes. It is expected that Pan American will handle this responsibility which includes:

• **Clearing of the range** prior to a missile launching by means of "polly" planes that cruise the entire area, equipped with loudspeakers for warning ships and small fishing boats to vacate the range.

• **Control of missile** once it becomes airborne, with the power to destroy the bird if it should veer off course or fail to respond to control.

Destruction of a missile is accomplished by means of a destructor mechanism actuated by a firing key operated at the cape launching site.

Automatic plotting of radar data tells just where the missile is located inside the range.

Skyscreens check the radar plots by visual observation through a gridded telescope field; operators report back to inflight safety at the cape.

► **Automatic Range**—Ultimate goal is a completely automatic range, insofar as data recording and reduction goes. Air Force expects that Pan American and RCA technical know-how will be the means to this end.

Right now, tracking data is taken manually and punched on tapes to be fed into the SEAC computer of the Bureau of Standards. Telemetering data runs through automatic reduction equipment from the original tapes and is then fed to the computer.

All data belongs to the missile contractor. But during the learning stage for both Air Force and contractor personnel, data has been shared to evaluate range instrumentation as well as the missiles.

► **Extensive Service**—National defense contracts are nothing new to either Pan American or RCA. PAA saw extensive service in World War II: trained flight and ground crews, ferried military aircraft to the various fronts, built and operated air bases from Gambia and the Gold Coast in West Africa to supply British forces in Egypt, participated in world-wide airport development program and played a major role in the Berlin airlift in 1948.

The company also was the largest civil operator in the Pacific airlift during the Korean war.

For RCA, which also saw extensive World War II service, the AFMTC contract would seem to be another indication of the company's increasing interest in aviation activities. RCA's present activities include development of aircraft communications equipment, fire control systems and more recently, aircraft weather warning radar systems.

The company has been working under contract with ARDC in training Air Force technicians for duty at the missile test center.

Tacan Delay

Plans to install Tacan (new military navigation system) stations at five USAF bases, three in California and two in Nevada, reportedly are held up by Los Angeles Regional Airspace Subcommittee pending Washington's clarification of Tacan's "relationship . . . with the common system." California Tacans were to serve as terminal landing aids, those in Nevada as enroute aids.

ATA Blasts Decision To Complete DME

Air Transport Assn. has criticized as "untimely" Civil Aeronautics Administration's decision to complete installation of the civil DME (distance measuring equipment) air navigation system (AVIATION WEEK Feb. 15, p. 14).

Brig. Gen. Milton W. Arnold, ATA's vice president-operations and engineering, says:

"It is extremely difficult for us as representatives of users of the airspace to see why the CAA is going full-steam ahead on implementation of DME when there is no urgent operational requirement at this time for DME. The value of the system of distance measuring, when applied in traffic control, cannot be realized until some answer is provided to the problem of DME versus Tacan (tactical aerial navigation).

"A large sum would be involved in the installation and operation of CAA DME equipment at a time when the completion of the VOR range program is an absolute 'must,' the shortage of traffic control personnel is acute, and there are a number of spots where the decommissioning of low frequency ranges are being considered because of lack of funds.

"Adequate navigational aids, communications, and traffic control personnel are absolute requirements at this time; yet CAA apparently is ignoring these problems."

The scheduled airline organization says it repeatedly has requested in writing and verbally that the program of DME installation and operation be held in abeyance until the problem of DME versus Tacan could be resolved. Until that is done, ATA claims, there is no justification in asking airlines to spend millions of dollars for this equipment.

ATA says the CAA announcement indicates the problem is solved and that airlines should immediately procure DME equipment.

"In addition, with military and civil aircraft using the same airspace, the conflicts that may arise through general use of two systems would be detrimental to orderly expansion of both military and civil aviation," the association charges.

"Two systems would put an added workload on traffic control and further complicate the traffic control problem, which is now the most critical in aviation," ATA says.

BOAC Asks Slower Turbine Development

Sir Miles Thomas, chairman of British Overseas Airways Corp., has applied verbal brakes to jet transport development in Britain.

In the Brancker Memorial Lecture delivered this month, Sir Miles said: ". . . In this year . . . and possibly in 1955, we ought to take time out for meditation and free-thinking . . . . It is imprudent to make any long-term decision."

► **Wait-and-See Policy**—Observers this side of the Atlantic see this statement as formal notice that Sir Miles, first and principal customer for any future British transports, has adopted a wait-and-see policy towards the purchase of any successors to BOAC's present gas-turbine fleet of de Havilland Comets, Bristol Britannias on order and Vickers Viscounts.

Sir Miles noted that there still is no British aircraft that will fly the Atlantic competitively and profitably. Five British manufacturers—Avro, Handley Page, Vickers, de Havilland and Bristol—are beating the drums for future transports of their own designs, featuring layouts already proven to their own satisfaction.

Each of these transport designs is claimed to be the answer to the North Atlantic route problem (AVIATION WEEK Dec. 14, p. 32).

► **Time to Decide**—But Sir Miles stated: ". . . We shall have good notice of the necessity for introducing new types to follow the existing known range of Comets and Britannias and Viscounts.

"It will then be time to make up our minds whether the next . . . aircraft will be deltas with buried bypass engines in the wings, or sweptwing designs with conventional tails; whether the power unit will be a straight jet or turboprop, whether the aircraft will be a land plane or a flying boat."

Such an aircraft might even have podded engines, Sir Miles hinted, in asking designers not to close their minds to the possibility.

The airline executive acknowledged that American competition could put on the pressure for further performance development and that U. S. industry could produce ". . . a fine workmanlike job in vast quantities."

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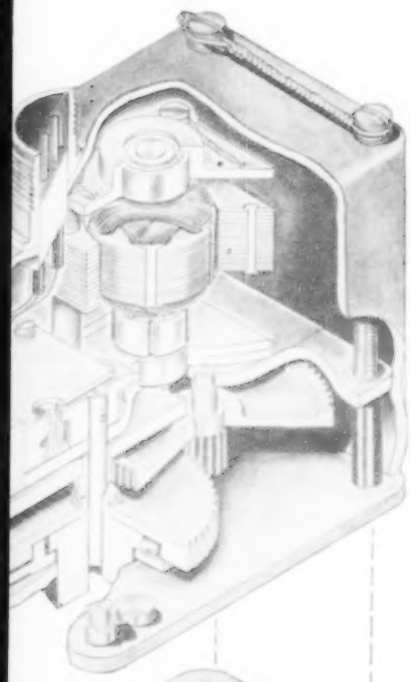

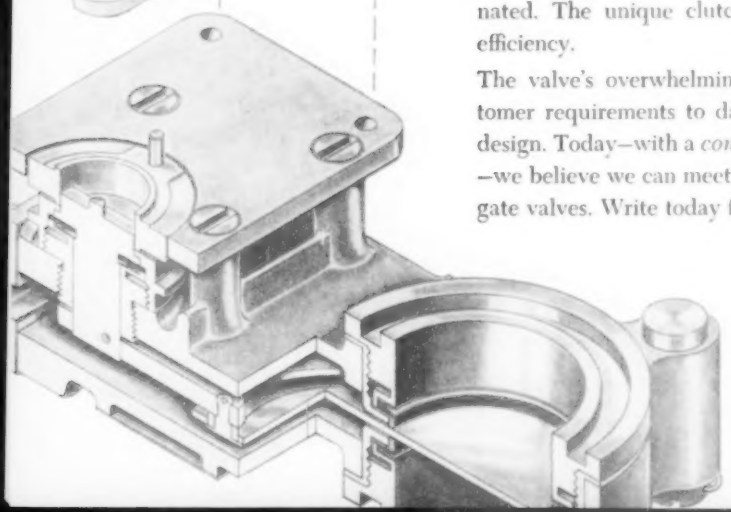

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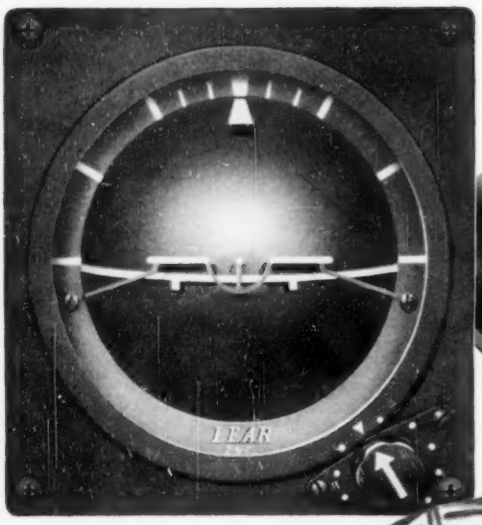

LEAR VGI SYSTEM Non-tumbling horizon gyro (in roll), provides greatly improved accuracy, reduced turn errors. The system includes 24,000 rpm gyro motor and a highly sensitive Lear electrolytic erection switch.

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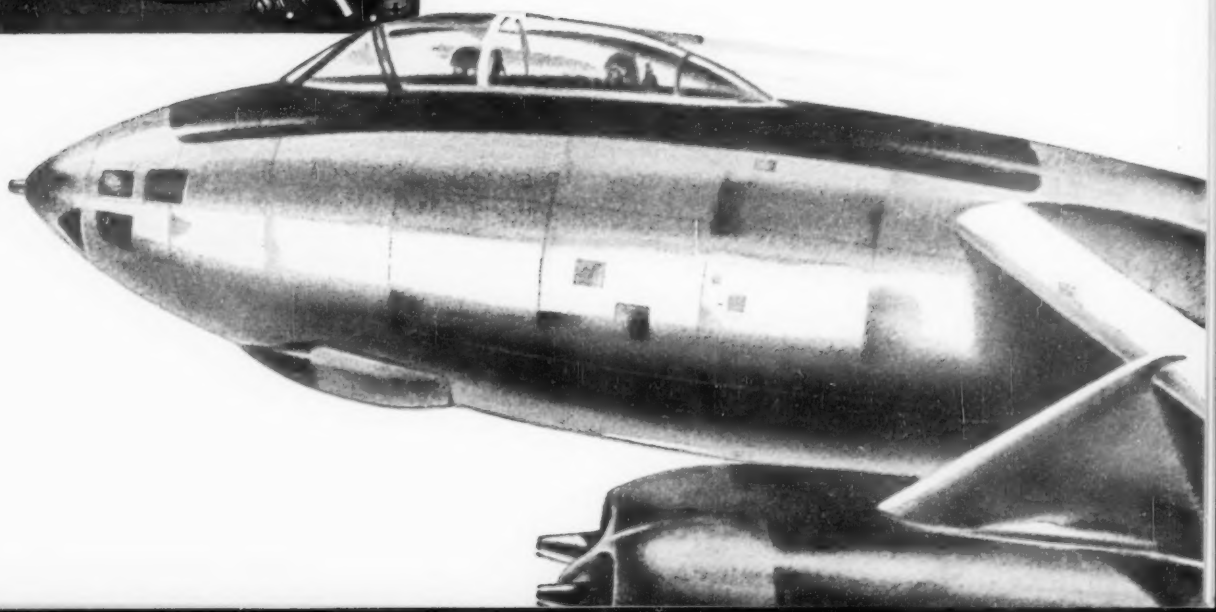


NAA Reports Top Executive Salaries

North American Aviation paid its board chairman, J. H. Kindelberger, $168,750 for the fiscal year ending Sept. 30, the firm reports to Securities & Exchange Commission.

J. L. Atwood, NAA president, received $125,500; R. A. Lambeth, vice president and treasurer, $59,500; Raymond H. Rice, vice president, $66,000; and J. S. Smithson, vice president, $59,692.

All officers and directors received a total of $630,097 for the year.

North American reports its top executives will receive the following income when they retire at age 65: Atwood, $18,000; Kindelberger, $18,000; Lambeth, $13,264; Rice, $16,068; and Smithson, $14,459.

Merger Chances Fade For Pacific Airlines

(McGraw-Hill World News)

Melbourne—Britain, Australia and New Zealand probably will not approve an agreement calling for the merger of three large Pacific airlines into one strong carrier capable of competing with Pan American World Airways, authorities here report.

The three governments are not satisfied with parts of the plan to combine British Commonwealth Pacific Airways, Tasman Empire Airlines and Qantas Empire Airways (AVIATION WEEK Sept. 22, 1952, p. 68) and are not expected to ratify the agreement in its present form.

Extra-Fare Flight

Surcharge of $3 each way will be placed on United Air Lines executive, "for men only" flights between Chicago and New York, establishing the only extra-fare service in U. S.

Scheduled to go into effect Mar. 16, the new rate is subject to Civil Aeronautics Board approval.

On Mar. 10, UAL will charge from $3 to $10 for private staterooms on Pacific Coast Stratocruiser flights.

▶ **Airline Opposition**—At least one of the carriers also is opposing implementation of the merger.

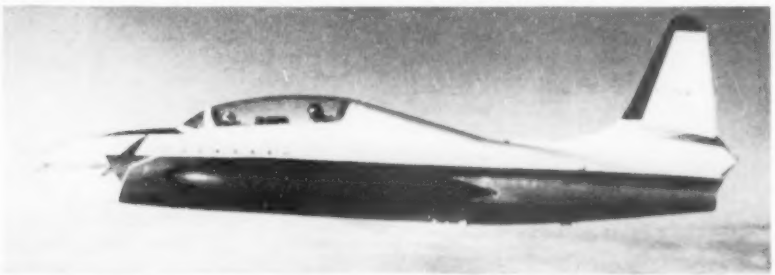
Industry observers predict the three countries will not start new talks to iron out disputed parts of the agreement because the original plan took more than a year of discussions and negotiations.

Lack of an agreement means BCPA will continue operating under its present ownership, or with slight changes, for the next few years.

▶ **New Fleets**—The airline's executives are scheduled to take delivery of Comet 2As at the end of this year, despite fear in certain Australian circles that de Havilland's jet transport will prove uneconomical in this area.

BCPA's officials believe the Comets will add to the carrier's presitge and passenger appeal.

The airline may use its DC-6 fleet in trans-Pacific coach flights and sell some of the U. S.-produced transports to Tasman, which will need replacements for its flying boats if the merger agreement is not ratified.



New Jet Trainer

First views of a new two-seat jet trainer developed by Lockheed Aircraft Corp. with private funds shows many new features based on firm's experience with the T-33. Designated L-245, this prototype is powered by an Allison J-33-A-16A of increased thrust, features a tail-mounted drag chute and automatic leading edge wing slats (left). Although similar to the T-33, the L-245 has a higher, larger horizontal stabilizer and instructor's seat is raised six inches to improve observation of student while flying. The L-245 will visit AF and Navy bases soon.

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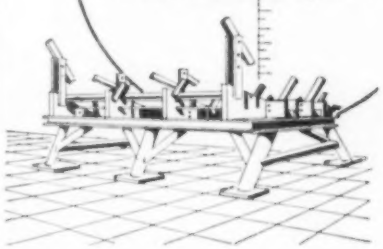

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Artouste Makes Good in Sikorsky S-52

• Firm says French gas turbine gives high speed, climb rate; claims control problems are solved.

By David A. Anderton

Bridgeport, Conn.—Startling climb and highspeed performance characterize a modified Sikorsky S-52 helicopter powered by a Turbomeca Artouste 2 gas turbine.

On flight status for a little over seven months, the S-52-5 flying testbed has been racking up successful flight hours with a powerplant and drive system that most helicopter engineers had earlier doomed to failure.

But Sikorsky engineers believed that reliable engine control was the answer to the prophets of failure, and went ahead with the installation. Its performance has exceeded their hopes. They couldn't be more pleased with any powerplant, nor with the sprightly performance of the rejuvenated copter, they say.

▶ **First Details**—Ralph P. Alex, Sikorsky development engineer on special projects, told the first details of the engineering and design aspects of the modified helicopter to AVIATION WEEK.

"In the first place," said Alex, "there's no point in using a gas turbine unless you can increase the performance of the helicopter. We've done that, of course.

"But we get more than improved performance," he pointed out "We get the control system we've been hunting for 12 years. It's easier to fly the ship because engine control and governing is so reliable and precise that we eliminate all coordination between throttle and collective pitch. The pilot just touches the throttle once to start the engine and engage the rotor before he begins to fly and doesn't touch it again until he's through."

▶ **Powerplant Scheme**—The controversial engine is the Artouste 2, French-designed and-built gas turbine. It develops over 400 hp. for takeoff and weighs about 230 lb.

The engine it replaced was an Air-cooled Motors, Inc., O-425-1 reciprocating engine rated at 245 hp. for takeoff and weighing 372 lb.

Substitution of the gas turbine for the piston engine results immediately in a powerplant improvement factor of about three. Nobody will contest that advantage of the gas turbine.

GAS TURBINE changes Sikorsky S-52-2 (Army H-18 version shown here) to S-52-5.

The argument comes when you start to talk about the way to take power out of the engine through the turbine and deliver it to the rotor.

There are two ways to do this. In the Artouste, the turbine and compressor are on the same shaft. This arrangement is called a "fixed-shaft" or "coupled" turbine.

In contrast, the Boeing 502 gas turbine—earlier installed and flown in a modified Kaman K-5—is characterized by what is called a "free" turbine. There is no direct mechanical connection between turbine and compressor.

In both cases, the turbine output shaft drives the rotor head through a conventional geared transmission. The only difference—and the only point of controversy—is the connection between turbine and compressor. In a fixed-turbine engine, the shaft is the link; in the free-turbine engine, the working medium—air—is the link.

▶ **Difference**—The design difference between the two turbines results in completely different throttle regulation requirements for a constant output rpm.

• **The "fixed" turbine** requires only one speed control or governor to maintain constant rpm. while the rotor varies from the no-power condition of autorotation to full power. The engine does this easily because of its high rotational inertia.

• **The disadvantage:** If a "topping governor"—which is a limiter on maximum power—is installed and the rotor demands more torque than the engine can deliver, the rpm. immediately and steeply falls off, and the engine overheats. The rotor demand must be reduced immediately, to prevent engine failure.

• **The free turbine** engine with topping governor will decrease its rpm. slightly if the pilot calls for excess power. This rpm. decay will stop at a reduced value of rpm., because torque increases with rpm. decrease in this type of engine. This characteristic acts as a safety device against possible serious loss of rpm. during full-power operation.

• **The disadvantage:** Speed governing is more difficult because of the very low power wheel inertia. To get a constant output shaft speed over a wide range of rotor power requirements, it is necessary to design a complex governing system to control both output and input power sections of the engine simultaneously.

If aircraft performance is based on normal maximum power output and takeoff power is reserved for hot-weather or emergency operation only, the disadvantage of the fixed turbine—its critical characteristic at maximum power output—seems to present no particular problem, says Alex.

This "de-rating" of the engine should also increase service life and reliability.

▶ **Control**—According to Alex, the French control system on the Artouste engine is just the answer. The engine delivers a constant-speed output to the rotor within 2%. Governing of that speed is precise, excellent and completely self-contained within the engine.

The control unit is mounted under the compressor section of the engine. It's about as big as your two fists, placed thumb to thumb. Inside is a flyball

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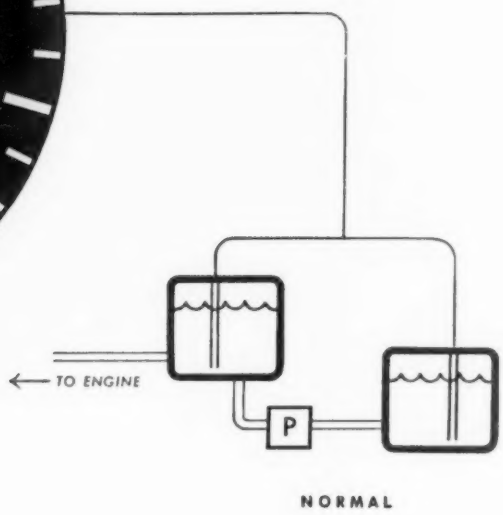
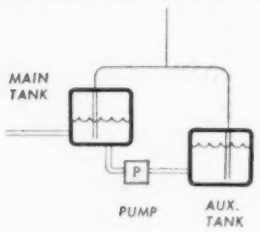


NORMAL

Have you heard about AVIEN'S "LIE DETECTOR"?

In a certain new Douglas airplane the pilot flies over 750 miles an hour. He must know at a glance how much fuel he has. But if the gage merely showed total fuel, it could "lie." This Avien system registers only *engine - available* fuel.



EMERGENCY

Thus, if the auxiliary tank stops feeding the main tank, the useless contents are automatically dropped from the indicator total.

Avien has built this "lie detecting" function into its Two-Unit Fuel Gage by the simple addition of a level switch—*as an integral part of the Fuel Gage tank unit.* Note that this added function has been accomplished without added components.

Avien has solved such problems for more than 50 different types of aircraft. Essentially, Avien "tailor-makes" each gaging system to meet specific needs, with the same care and skill that went into the original design of the now widely used line of Avien gages.

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AIRCRAFT AND INDUSTRIAL INSTRUMENTATION

governor which senses minute changes in rpm. and, reacting violently to them, change the fuel flow.

Transients—the time-lags in the system—have been carefully worked out by the French designers of the Turbomeca engine so that there is no overshoot or undershoot during regulation. The reaction to the rpm. change is damped, and results in the precise governing which has made the Sikorsky installation practicable.

Governing rpm. is preset on the ground by adjusting a simple linkage outside the control unit. After the engine is started, the pilot opens the throttle and leaves it open; the governor regulates engine speed. He doesn't touch the throttle again until the flight is finished.

► **Easier Flight**—This aspect of the engine control system has simplified flight in the S-52-5, says Alex. There is no throttle on the collective-pitch stick at the pilot's side. Student pilots will not have to spend time learning the coordination between power settings via the motorcycle grip and position of the collective pitch stick.

After the recent demonstration of the S-56 assault copter, the few observers who remained behind were treated to an informal flight demonstration of the S-52-5, with senior test pilot Robert Decker at the controls.

Decker fired up the engine, engaged the rotor and was airborne in a matter of a minute or less. The rotor accelerated from a standing start to full speed in a few seconds, a figure observed to be far below the acceleration time for any of the other Sikorsky copters.

Decker climbed out steeply at a blistering rate, and then made a few high-speed passes across the concrete heliport fronting the Sikorsky hangars. He demonstrated the maneuverability of the little craft, hovered a short time and then made one more pass before landing. He taxied in toward the crowd, spun the ship around—causing all observers to turn away, expecting a blast from the jet exhaust which never came—and shut off the engine.

► **No Blast, Little Noise**—You notice two peculiarities of the turbine powerplant when you see and hear such a demonstration. First is the almost complete absence of any highspeed jet blast. The tail rotor is mounted about a dozen feet behind the exhaust, and there is no indication of any erosion or temperature effects on rotor or boom.

Second is the highly directional noise pattern. Directly to the rear, the noise level is moderate; directly forward, it's almost absent. At each side, the noise level is high. Alex says that inside the cabin, it's quieter than any other of the Sikorsky copters.

► **Engineering**—The current version of the S-52-5 represents about eight

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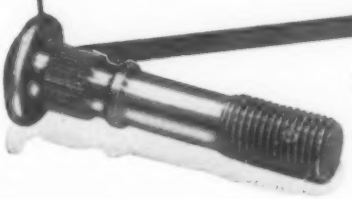
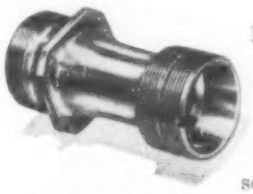
. . . in large or small lots, from all types of stainless steels and other heat- and corrosion-resistant materials. Unusually extensive secondary operation equipment, inspection and quality control facilities, and experimental and research techniques insure highest quality work. Capacities from 1/32" to 3½" round on bar machines — up to 8" round on chuckers.



Bolts of this type, in aircraft quality, are produced in large volume. Blanks are made on multiple spindle New Britains and parts are then processed through heat treating, form grinding, roll knurling and roll threading. Interesting features of this bolt are the hardness of Rockwell 35-38, concentricity requirement of .001 T.I.R. and squareness requirements of .002 T.I.R. between surface under head and body diameters and an exact number of 46 teeth in the knurl.

This part is blanked on a multiple spindle machine, using 3½" diameter tubing AMS 5645. Part is plunge ground on the body diameter and an additional forming is performed on a turret lathe. The entire internal form including all three internal diameters, tapered seat, radii, front and back chamfer are single point bored on a Model 36 New Britain contour boring machine. This is done all in one setting, to insure the internal form being concentric and being within .002 T.I.R. with the body diameter. The smallest internal diameter is then ground to a tolerance of .001.



Parts are blanked with a cut thread, out of aluminum bar on a Model 61 New Britain six-spindle screw machine. Parts are then rechucked on a Model 65 New Britain chucker to machine the opposite end at the angular displacement of 2° 34', holding a total angular tolerance of 0° 10'. Subsequent operations include milling the square and end slot, multiple drilling wire holes and grinding threads in three different sizes, maintaining a class 4 tolerance.

This part requires a hard shell of Rockwell 60-65 and a depth of case of .025 to .040. The micro finish of 8 and the tolerance of .0002 on the O.D. are produced through grinding and lapping operations. Parts are made from AMS 6260 steel and processed in controlled lots to insure proper depth of carburization and hardness.

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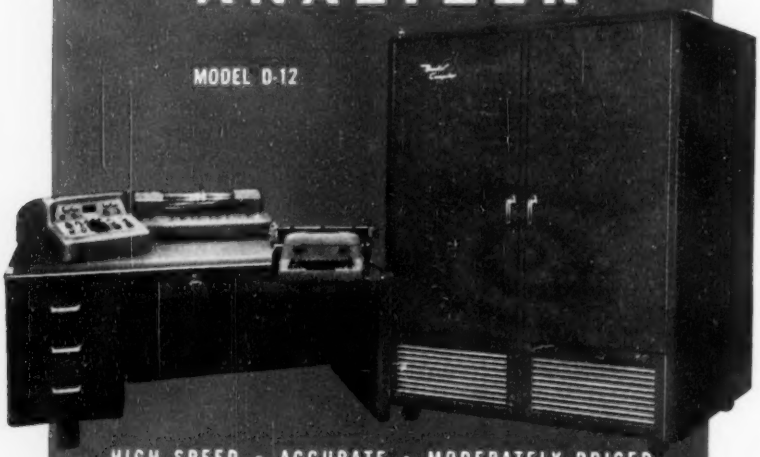

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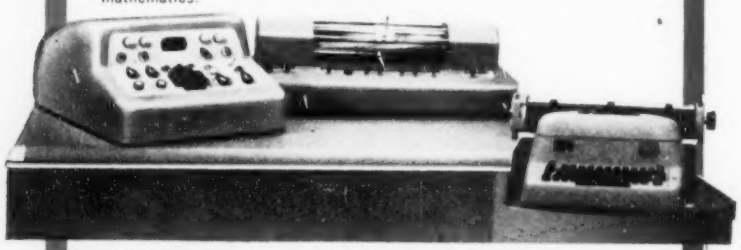

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months of engineering work before the craft first flew. Engineering redesign was started with the Artouste 1 in mind, fixed in a jury-rig arrangement to get some of the flight characteristics of a gas-turbine-powered copter and to find out more about the fixed-shaft system.

But the Artouste 2 came along faster than expected, and somewhere in the middle of redesign, the powerplant was changed.

There were design problems of a minor order, according to Alex, but no major troubles. "We put the engine in and had the ship flying in a few days," he says.

A four-blade metal rotor replaces the original three-blade design. Fuselage modifications had to be made because of the powerplant design. Instead of the enclosed installation common to many piston-engine copters, the Artouste 2 is right out in the breeze on top of the fuselage, covered by a light removable cowling.

By spring, the fuselage will be redesigned to eliminate some of the temporary features of the installation and to improve the lines.

The engine is simply bolted to a flange on the transmission gearbox; no engine mount is required. Alex says that the engine weight is actually less than that of the transmission, and that this makes powerplant engineers start to think of the engine in terms of an accessory.

► **Logged Time**—Currently the S-52-5 log book shows about 20 hr. of flight and ground testing.

It's flying under one limitation: The pilot isn't allowed to use full power, but has to keep under 320 hp., the level at which the airframe was certificated.

This is because of the history of the copter. Originally designed as a two-place craft with 145 hp., it grew to a four-placer with about 300 hp. available for takeoff. There was some rework, but the original airframe was good enough to take the increased loads of the extra speed and weight it carried in its new role.

But the jump to 400 hp. is more than the original airframe can take, hence the current limitation, and the impending redesign of the fuselage. With that step out of the way, the company wants to get the copter certificated by CAA at the higher horsepower rating.

As the HO5S, the craft saw service in Korea; between six and 15 worked for the Marine Corps. Sikorsky engineers—including among them Alex who spent three months in Korea flying with the Marines and observing the firm's products in action—wanted more horsepower.

The Artouste installation has provided the answer to that want.

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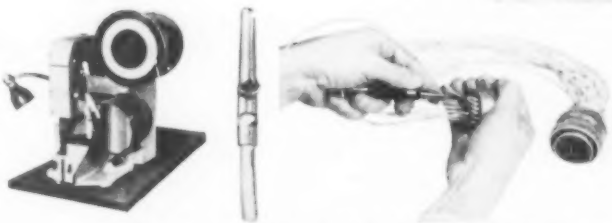

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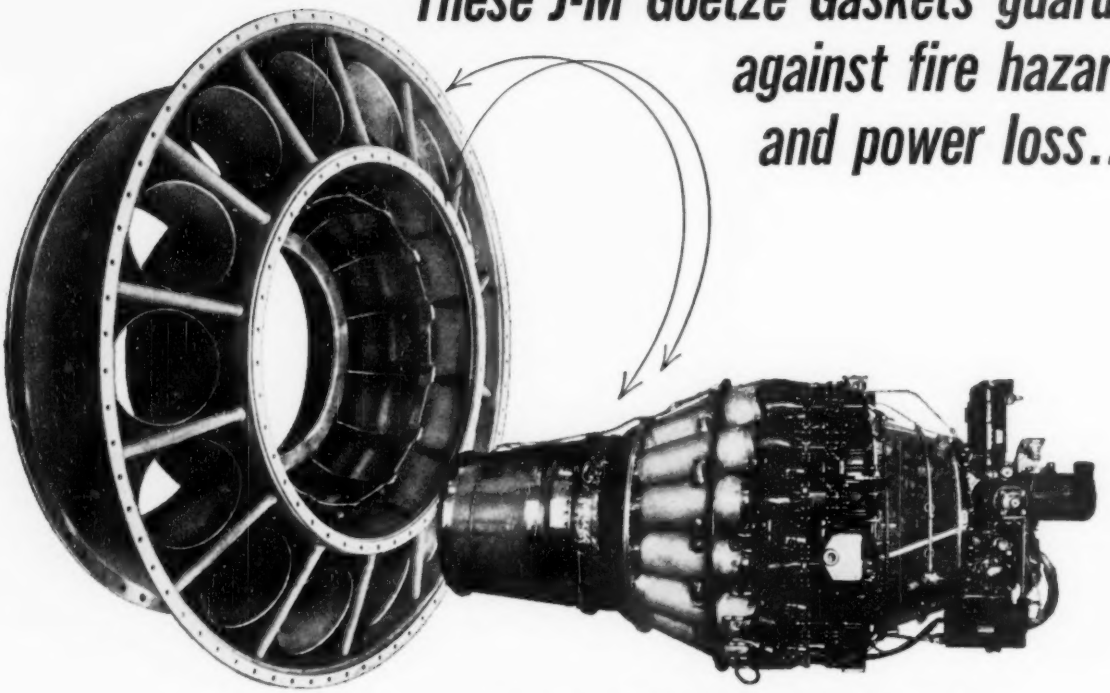

Arrows point to J-M Goetze metallic gaskets on the inner and outer annulus, and their approximate location on the J33 turbojet engine turbine frame.

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Sealing the inner and outer annulus on the J33 to prevent leakage of fuel and flame into the airframe is another example of the many tough, critical sealing jobs entrusted to Goetze custom-crafted metallic gaskets.

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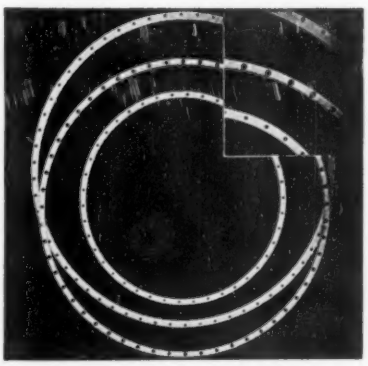

Close-up of J-M Goetze metallic gaskets used as inner and outer annulus gaskets on jet engine turbine frame.

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IAS Summaries

This article continues the publication of summaries of papers prepared for the Institute of the Aeronautical Sciences' 22nd annual meeting, recently held in New York.

Previous installments appeared in AVIATION WEEK Feb. 8, p. 43 and Feb. 1, p. 46.

Aeroelasticity

► **Stiffness and Deflection Analysis of Complex Structures.** M. J. Turner, R. W. Clough, H. C. Martin, and L. J. Topp, Boeing Airplane Co.

A procedure is developed for calculating load-deflection data for aircraft structures. This method is intended for use in dynamic and aeroelastic analyses of highspeed aircraft, utilizing highspeed digital computing equipment. The suggested procedure represents an extension for shell-type structures of the fundamental method of joint displacements. Particular emphasis is given to thin, low aspect ratio wing structures.

The structure is first considered as spar, rib, cover skin, and stiffener segments. Stiffness coefficients are then determined for each of these component units. A new approach is presented for determining the two-dimensional stiffness properties of quadrilateral plate elements. Superposition of component stiffnesses leads to the stiffness matrix for the complete structure.

This method of analysis is sufficiently comprehensive to include such complex effects as camber bending, cross-coupling of bending and torsion, shear deformation of spar and rib webs, shear lag, and other miscellaneous effects associated with general two-dimensional stress distributions in the cover skins.

► **Analysis of Flutter in Compressible Flow of a Panel on Many Supports.** John M. Hedgepeth, Bernard Budiansky, and Robert W. Leonard, Langley Aero. Lab., NACA.

Two-dimensional linearized compressible flow theory is used, together with elementary beam theory, to analyze the dynamic stability of an infinitely long panel on equally spaced supports, having an air stream of arbitrary speed on one side and dead air on the other. It is assumed that the flutter mode has a spatial periodicity of two bays. Longitudinal stresses in the panel are taken into account.

An exact solution for the condition of neutral stability yields two independent equations in the form of rapidly converging infinite series. The results of some numerical calculations made on the basis of the first few terms of one of the series are shown and discussed. A technique for distinguishing between states of stability and instability on either side of a flutter boundary is described and applied.

Aerodynamics

► **An Investigation of the Aerodynamics of Sharp Leading-Edge Swept Wings at Low Speeds.** C. E. Pappas, Chief, Aerodynamics, and A. E. Kunen, Principal Aerodynamicist, Loads Sect., Republic Aviation Corp.

The aerodynamics of three-dimensional flow over swept wings with sharp leading edges is discussed, and an attempt is made to establish the character and effects of the spiral conical vortex formed at the sharp leading edge of a swept wing.

Potential flow equations for a flat plate, with the addition of a point vortex near the leading edge, are used to determine the streamwise flow conditions at various span stations. For a given vortex location, the vortex strength and airfoil circulation are determined by satisfying the Kutta conditions at the leading and trailing edges. The lift due to circulation is modified by the presence of the leading-edge vortex.

The spanwise variation of the slope of the lift coefficient is obtained by combining, at a determined location, the point vortex with the potential flow over a flat plate. Finally, the calculation of span load distribution, allowing for the presence of the rolled-up free vortex at the leading edge, is discussed.

► **The Estimation of Normal-Force, Drag, and Pitching-Moment Coefficients for Blunt-Based Bodies of Revolution at Large Angles of Attack.** Howard R. Kelly, Aerodynamics Br., U.S. NOTS, Inyokern.

A method is developed which accurately predicts for blunt-based bodies of revolution the normal-force coefficient and pitching-moment coefficient for angles of attack far beyond the range of potential theory. The method is based on the superposition of the results of potential theory and the viscous force on a cylindrical body due to the transverse component of flow. In contrast to previously used methods, the viscous cross-force is assumed not to be in a steady state but in a transient development along the body.

This method is compared with experimental data for both subsonic and supersonic flows and for both laminar and turbulent boundary layers. An extension of the method to the prediction of the drag-coefficient increment due to yaw is made and is compared with subsonic data. The deviations between theory and experiment are in most cases an order of magnitude smaller than for previously used methods.

► **Some Nonlinear Aspects of Missile Motion.** J. C. Crown, Group Leader—Aerodynamics, Research Dept., United Aircraft Corp., and S. Fagin, U. S. NOL, White Oak.

This paper deals with several aspects of missile motion which cannot be treated satisfactorily by linear theory. First, nonlinear pitching moments are treated. Consideration of the effects of this nonlinearity is particularly important for missiles with low static stability. A simple analytic method is derived which permits rapid solution of both the direct problem of finding the pitching frequency from windtunnel data and the inverse problem of finding the pitching moment from free-flight data.

Thus, free-flight data involving higher yaws can be evaluated accurately and readily. The method presented herein has been applied using data from the NOL Pressurized Ballistics Range. The computed pitching moments checked well with measured values obtained in the NOL windtunnels, while calculations based on linear theory yielded large discrepancies.

Nonlinear pitching moments, in addition to causing a quantitative change in pitch frequency from the linear-theory value, introduce a precession aside from that due to spin.

Coincidence of the spin and pitch frequencies has been found to cause missiles to develop a stable, circular motion with large yaw. This "resonance" phenomenon is discussed. Methods of minimizing the effect are presented for those cases when resonance cannot be avoided. If, now, a

Copter Features Single-Stick Control

This two-place personal and business helicopter is being tested by Glenview Metal Products, Inc., Delanco, N. J., which calls the craft the Flyride. Simplification of controls enables all maneuvering, ascent, descent, forward, sideways and reverse flight to be accomplished by using a single control stick, says the firm. The Flyride also has an automobile-type floor-pedal accelerator. The vibration damping and single-stick control system were developed by William Hunt, who has been working on the copter for several years. Plans are to place it on the market by mid-1954 in the $10,000 class. Powerplant will be a 140-hp. Lycoming, expected to give the Flyride a top speed of 108 mph. and 1,200-fpm. climb. Empty weight: 1,150 lb.; useful load: 505 lb.

missile has a design spin frequency higher than the pitch frequency, then a transient condition involving resonance will occur some time after launching. The present analysis indicates that this transient resonance is not likely to have an adverse effect on missile stability.

The importance of these nonlinear effects indicates that linearized theory should be used with caution.

▶**The Transition from a Turbulent to a Laminar Boundary Layer.** Joseph Sternberg, Chief, Supersonic Wind Tunnels, Ballistic Research Lab., Aberdeen Proving Ground.

The boundary layer on a 58-deg. included angle cone-cylinder model has been studied over a range of supersonic speeds. Wind-tunnel measurements of the boundary-layer recovery factors along the model have been made, and shadowgraphs to show the state of the boundary layer have been taken both in the windtunnel and free flight. These data indicate that, when the boundary layer ahead of the shoulder is turbulent, the boundary layer is laminar after the shoulder for a short distance.

A theoretical model of the phenomenon has been constructed, and calculations have been made using available boundary-layer theory and experimental data to describe the course of the boundary layer from just ahead of the shoulder to the transition back to turbulent flow on the cylinder. The results of the calculations are felt to provide a reasonable description of the phenomenon.

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▶**Experimental Investigation of Turbulent Boundary Layers in Hypersonic Flow.** R. Kenneth Lobb, Eva M. Winkler, and Jerome Persh, U. S. NOL, White Oak.

The results of an investigation in the NOL 12- by 12-cm., hypersonic windtunnel on naturally turbulent boundary layers at Mach numbers of 5.0, 6.9, and 7.7 with and without steady-state heat transfer to the wall are given. The Reynolds number based on boundary-layer thickness was varied from 160,000 to 300,000. Measurements of pitot and static pressures, total and wall temperatures, and heat-transfer coefficient made it posible to compute velocity profiles, shape parameters, etc., without resorting to any assumptions.

The turbulent boundary-layer velocity profile was found to differ from the von Karman incompressible flow semilogarithmic law plot. The velocity profile in the laminar sublayer has a linear distribution. Local skin-friction coefficients as calculated from the velocity gradients at the wall and also from the heat-transfer coefficients using a modified Reynolds analogy agree with the values obtained by extrapolating the results of other experimenters at lower Mach numbers.

Structures

▶**A New Approach to the Bending of Plates Under Normal Pressure.** Ralph H. Upson, Prof., Dept. of Aero. Engrg., University of Minnesota.

This paper shows by example a method of approach to a generalized engineering problem, based on simplifying assumptions, but arranged for the application of correction factors by which any desired approach to exact theory can be made. These factors, employed as pseudoconstants over any appropriate range of conditions, permit use of the simplified expressions on which differentiation and other operations can be readily performed.

The procedure is applied to the behavior of a long plate under normal pressure, with any flexural rigidity from zero (the so-called membrane type) to the case where all load is carried by bending stress (the Kirchhoff plate). The method allows for initial curvature, slack or tension, and for any known strain or deformation of the supporting structure in both of the principal directions. A further example of a circular plate compares the results from approximate and exact theory and from experiment.

▶**On the Concept of Stability of Inelastic Systems.** D. Drucker, Chairman, Div. of Engineering, and E. I. Onat, F. B. Jewett Fellow in Applied Mathematics, Brown University.

Simple models are employed to bring out the large and important differences between buckling in the plastic range and classical elastic instability. Static and kinetic criteria are compared and their interrelation discussed. Nonlinear behavior in particular is often found to be the key to the physically valid solution. The nonconservative nature of plastic deformation in itself or in combination with the nonlinearity requires concepts not found in classical approaches.

Conversely, the classical linearized condi-

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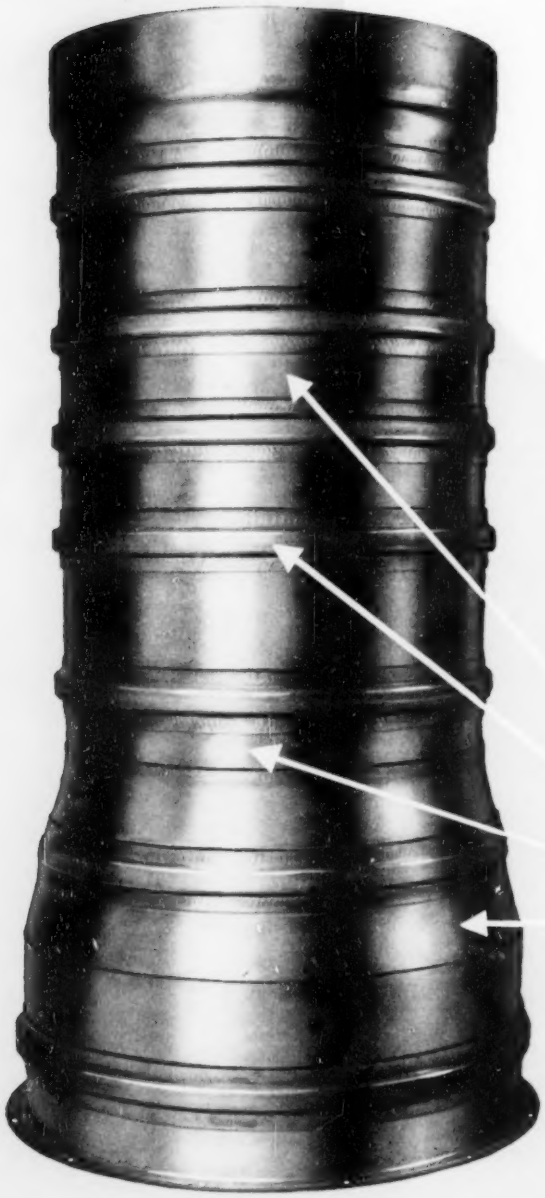

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tion of neutral equilibrium is really not relevant in inelastic buckling. Plastic buckling loads are not uniquely defined but cover a range of values and are often more properly thought of as maximum loads for some reasonable initial imperfection in geometry or dynamic disturbance.

The models indicate that basically the same information is obtained from essentially static systems by assuming initial imperfection in geometric form as by assuming dynamic disturbances. One approach complements the other, and both are helpful in obtaining an understanding of the physical phenomena.

▶ **Prediction of Ultimate Strength of Skin-Stringer Panels from Load-Shortening Curves.** Norris F. Dow and Roger A. Anderson, Langley Aero. Lab., NACA.

The use of the load-shortening curves measured for short skin-stringer compression panels for the prediction of the ultimate strength of identical cross sections of any length and material is described. For short panels, predictions of the initial buckling stresses and the shapes of the load-shortening curves are also discussed.

Correlation between the short- and long-column range is effected from the slopes of the load-shortening curves for the short panels. The accuracy of prediction is compared with NACA test data for panels of various proportions and of a wide range of materials varying from ¾ hard 18-8 stainless steel to FS-1h magnesium alloy.

▶ **Strength Under Combined Tension and Bending in the Plastic Range.** J. M. Frankland and R. Roach, Chance Vought Aircraft, Inc.

A rational method is presented for the strength of rectangular sections under combined tension and bending in the plastic range. The analysis is based on the accepted theory of plastic bending as presented by Osgood and others. Nondimensional interaction curves between axial load and bending are presented for three types of stress-strain characteristics representative of artificially aged aluminum alloys.

Strength is presented in terms of allowable plastic strain at the extreme fiber. Some comparisons are made with tests on 75 ST-6 bars in pure bending. It is also shown how the change in curvature under load may be obtained, and suggestions are given for the use of this to calculate strength under statically indeterminate conditions.

▶ **On Inelastic Thermal Stresses in Flight Structures.** A. M. Freudenthal, Prof. Dept. of Civil Engrg., Columbia University.

The design of structural elements with respect to thermal stresses is usually based on the results of an elastic analysis of those stresses combined with a dual failure criterion in terms of a limiting deformation (creep or creep rate) and a limiting strength (creep fracture), both of which are functions of time. This discrepancy between the basis of stress analysis and of design (strength analysis) necessarily leads to high-temperature designs of considerable unreality.

After discussing the possible types of inelastic response of materials at elevated temperature, as well as the transient and

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This 300 amp d-c generator is manufactured by Jack & Heintz, Inc., Cleveland, for Boeing KC97, Convair C131, Douglas C124 and Fairchild C119 aircraft. Its installation demonstrates how a new ESNA® self-locking nut makes possible a faster, easier and safer method of mounting generators and similar accessories.

The new ESNA Z2278 nut has been designed for use with a keyhole type mounting flange. It is simply inserted through the keyhole slot (Fig. 1) and tightened into the recessed seating cavity. This cavity prevents the accessory from turning under stress, thus providing an extra safety factor (Fig. 2). An enlarged base diameter on the nut provides sufficient area to offset the seating area lost due to the slot in the flange—which the nut must straddle without brinnelling the flange. The ESNA "Z" or beam type locking device (for operating temperatures up to 550° F.) is incorporated in the nut design.

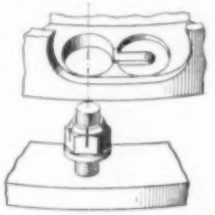


Fig. 1

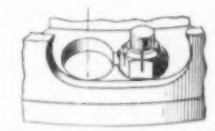


Fig. 2

Send us your fastener problem. ESNA ingenuity—and ESNA quality—will provide the most practical and effective solution.

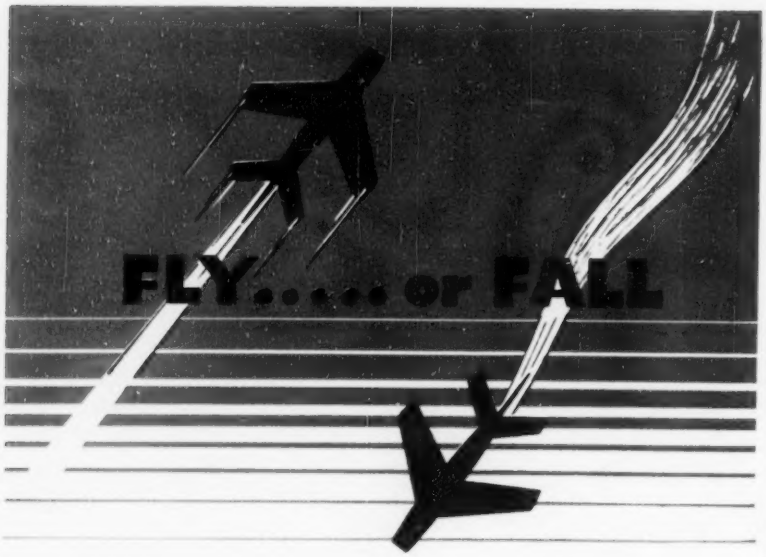
MAIL COUPON FOR DESIGN INFORMATION

Dept. N52-225, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

☐ Details on Z2278 ☐ Here is a drawing of our product.
☐ ELASTIC STOP® nut bulletin What self-locking fastener would you suggest?

Name _____ Title _____
Firm _____
Street _____
City _____ Zone _____ State _____



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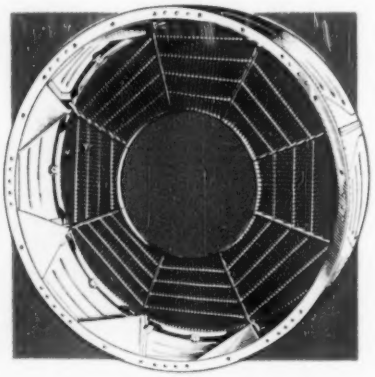

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stationary temperature distribution in flat plates under changing ambient temperatures, the effect of inelastic behavior on the thermal stresses in such a plate is analyzed under simplifying approximations. It is shown that inelastic thermal stresses due to transient temperature gradients may substantially differ from the elastic stresses not only in magnitude but in sign, temperature cycles being frequently accompanied by full stress reversals. At sufficiently elevated temperatures, stationary temperature gradients are not associated with significant thermal stresses.

► **Determination of Loads in the Presence of Thermal Stresses.** Samuel Levy, Chief, Aircraft Structures Group, NBS.

The determination of air loads by strain-gage instrumentation on airplanes in flight has been an important method of securing reliable load information. With the advent of highspeed flight and its associated problems of aerodynamic heating, the reliability of this method of load measurement has been subject to question because superposed on the stresses due to load will be the thermal stresses from a variable and unknown temperature distribution.

The paper presents a method for determining the loads on an aircraft structure when thermal stresses are also present. Equations are given for determining the axial load, shear load, and bending moment from the output of gages located at specified positions on the structure, provided that the stress distribution over the cross section of the structure can be approximated by a polynomial of third, fifth, or seventh degree.

Electronics

(Program Arranged in Cooperation with the Institute of Radio Engineers, Institute of Navigation, and Radio Technical Commission for Aeronautics)

► **Today's Air Traffic Control Procedures.** Jack Hilton, Airways Operations Specialist, Airways Operations Div., CAA.

This paper presents a description of the procedures in use today in the control of air traffic operating under instrument flight rules. These procedures are utilized by controllers in air route traffic control centers and airport traffic control towers.

The paper also treats briefly with the development of certain of these procedures through the past several years in order to show that, to some extent, today's procedures represent various stages in the historical development of air traffic control, depending upon the particular location involved and the amount of traffic existing at that location. Such factors as communications, separation standards, and control techniques are discussed.

► **Shortcomings of the Present Air Traffic Control System.** Stanley L. Seltzer, Air Traffic Control Specialist, Air Transport Association.

Radar has nearly doubled the capacity of the air traffic systems at major airports. This increased traffic rate has, in turn, thrown additional burdens on other parts of the system. The present air traffic sys-

Behind the PLEXIGLAS . . . *Proper Design*

The combination of properties in PLEXIGLAS acrylic plastic—clarity, strength, formability, resistance to weather—have made it a by-word for canopies, noses, astradomes and other transparent enclosures on all types of aircraft.

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The proper design of enclosures demands full knowledge of PLEXIGLAS. Over the years, Rohm & Haas Company, in addition to manufacturing an aircraft glazing material with the optimum balance of properties, has worked closely with the aircraft industry and the armed services so that plane designers will have a thorough understanding of acrylic plastic and can use the material to best advantage.

The Rohm & Haas Company manual, "Handbook for Aircraft Engineers", provides detailed physical data on PLEXIGLAS and outlines recommended practices in the design of transparent aircraft parts. Engineers who do not already have the revised (1952) edition are invited to write for a copy.

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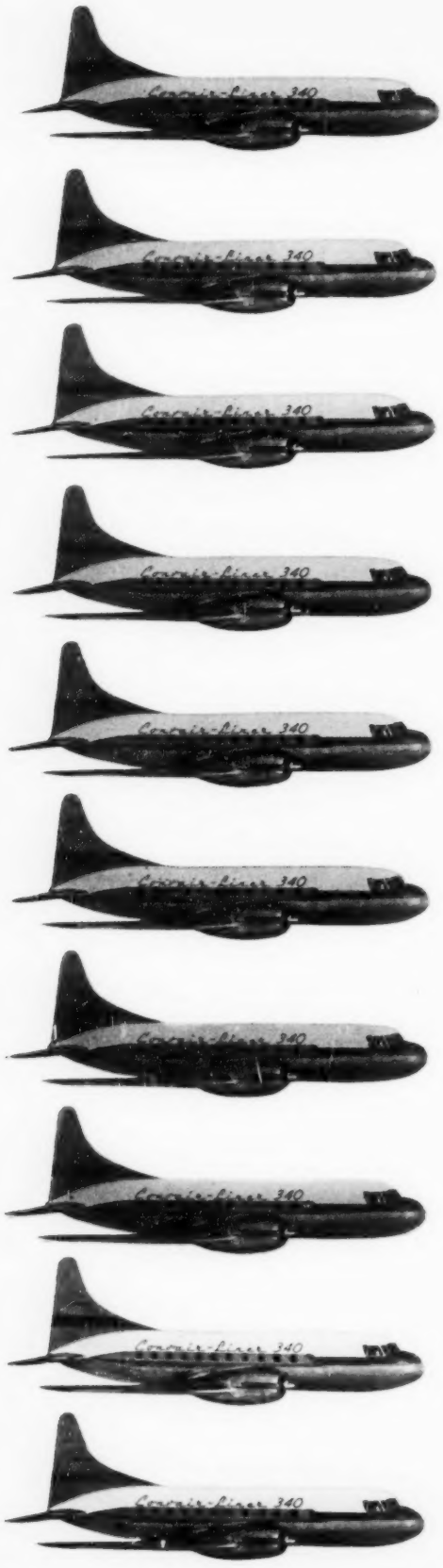

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80 Out of First 98 Convair 340's Use SKYDROL

Nothing succeeds like success. Skydrol, Monsanto's fire-resistant hydraulic fluid, passed its first CAA operational test 5 years ago. Today it is recognized as the standard of the industry. Twenty major airlines use it regularly in various aircraft; five of these lines also specify it for their Convair 340 fleets.

Skydrol eliminates the danger of fires caused by broken hydraulic lines. It exceeds the nonflammability requirements of AMS 3150.

Skydrol's lubricity is double that of conventional hydraulic fluids. Overhaul rate reductions resulting in savings of 20% or more are not uncommon with Skydrol users.

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Skydrol: Reg. U. S. Pat. Off.

tem is dangerously close to complete breakdown in the handling of extended, multiple airport terminal areas. The New York Air Route Control Center, for example, is currently finding it necessary to restrict traffic flow in peak hours. This is necessary to keep work load from exceeding human capability.

We are running out of "quick fixes." We need some of the shiny new gadgets we have been promised for years. Problems in navigation, communications, and the tools and methods of control are highlighted. The possible role of radar in these additional areas is analyzed. Jets are considered, and basic requirements of a new and better control system are outlined in the paper.

▶ **The Air Navigation Development Board's Program for the Development of an Air Traffic Control System.** D. K. Martin, Director of Development, Air Navigation Development Board.

The Air Navigation Development Board's program for the development of a common (military/civil) system of air traffic control is a direct attack on the airspace use problem.

The current status and plans for the future effort in this field are discussed.

The studies and surveys relating to the air traffic problem being made by contractors for the ANDB are described in their relationship to the establishment at Indianapolis, CAA Technical Development and Evaluation Center, of an airways evaluation traffic control center and to the long-term systems engineering effort on a future air traffic control system.

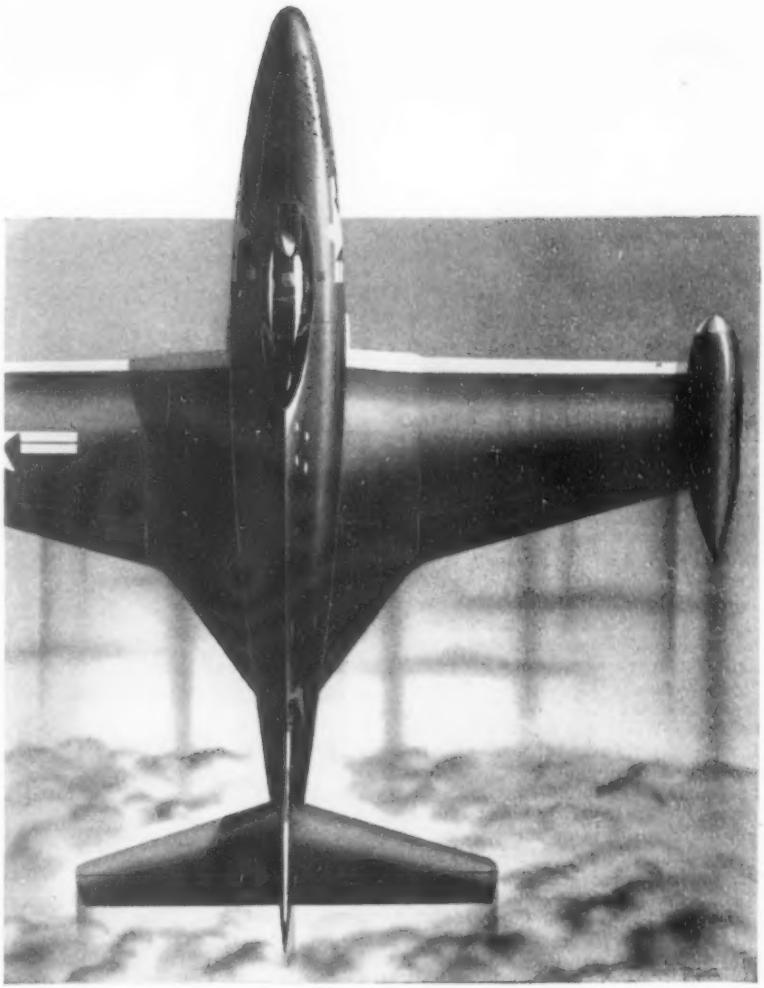
The first forward step in the development of a new traffic control system is described in terms of its principal elements, the arrangement and use of facilities developed recently—i.e., limited data transfer equipment, bright cathode-ray tube traffic display, magnetic drum for storage of traffic data, etc.—and older facilities—i.e., radar, VHF and UHF air-ground radiotelephony, teletypewriter communication, etc.

These are being organized to achieve the new air traffic control situation, emphasis being placed on developing the organization of facilities in the enroute area and on the evaluation of "direct radar control" of air traffic as an objective, the paper points out.

▶ **An Objective Look at the Airspace Use Problem.** S. P. Saint, Director, Air Navigation Traffic Control Div., Air Transport Assn.

In this paper a new type of semiautomatic control board is proposed for air traffic control. This equipment is designed to meet the requirements stated in the paper entitled "Shortcomings of the Present Air Traffic Control System."

The proposal set forth in this paper is intended to serve a dual purpose. Primarily it should provide grist for the development program. Also, and perhaps not less important, the specific proposal made here should demonstrate by example the need for a more intimate relationship between operational and technical considerations in developing a better air traffic control system.



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• **He revolutionized naval** warfare nearly 40 years ago through developing the first "mechanical brain" gunfire-control computer.

He designed the first automatic tracking bombsight and the first automatic computing sight for airplane machine guns.

He designed and built the first successful anti-aircraft computer and control (with some 55,000 moving parts in it).

Consequently Hannibal C. Ford has been one of the U. S. Navy's best-kept secrets since World War I, and is not known by the public at large. Although he has been retired from the presidency of the company he founded – The Ford Instrument Company – for ten years, the full story of Mr. Ford is just being made public.

• **Although most of Hannibal Ford's** early work was for the Navy, his company is now working for all branches of the armed forces, building intricate and unbelievably accurate devices for guided missiles, supersonic planes, and army ordnance. Masters of the new sciences of automatic controls and computing mechanisms, the hundreds of engineers and thousands of technicians at Ford Instrument Company are creating millions of dollars of electronic, hydraulic, electrical, mechanical and magnetic instruments each year. And their skills are being utilized by the Atomic Energy Commission and private industry as well.

• **To commemorate the name of its founder,** the company has established the Hannibal C. Ford Fellowship for advanced study in engineering at Cornell where Mr. Ford was graduated 50 years ago.

Each year Ford Instrument Company is offering positions to young engineers whose abilities qualify them to work on the exciting and important projects the company has contracted to develop. If you want to know more about Ford Instrument Company write for illustrated brochure.

15

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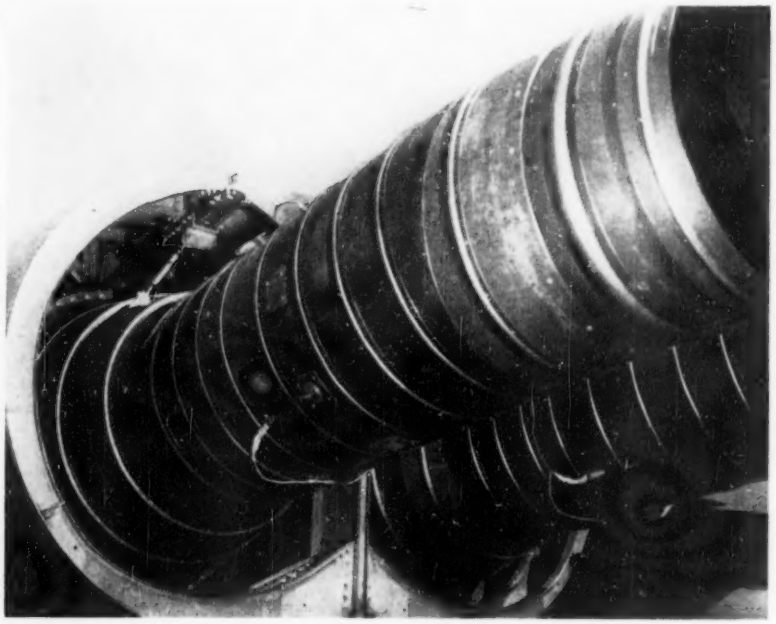

Titanium for Cutlass Jet Shrouds

Titanium afterburner shrouds are being fabricated on a production basis for Chance Vought Aircraft, Inc.'s J46-powered F7U-3 Cutlass.

Experimental units have been proved on an F7U-3 in flight test. No signs of corrosion, burning or cracking have been discerned after more than 30 hr. of flight. Use of the titanium material has permitted a weight-saving of 20 lb. per plane.

▶ **Committee Job**—Choice of the shrouds as a production item grew out of a development program sponsored by a special committee comprised of CV representatives from tooling, tool design, structures, materials, production design and manufacturing. Heading this group to investigate titanium applications for the F7U-3 was D. G. Andreoli, assistant project engineer.

Production runs followed the completion of two sets of shrouds from RC-70 titanium, commercially pure material supplied by Rem-Cru Titanium, Inc.

The committee's studies showed that production of titanium shrouds was feasible, provided adequate allowance were made for special forming characteristics of the material.

▶ **Experiences**—The conception that titanium, from a formability standpoint, is interchangeable with stainless steel, was discarded as erroneous by CV investigators. In a special report on the fabrication program, committee member F. N. LaMartine points out: "Direct substitution of titanium for stainless steel on stretch press operations resulted in uniformly complete failure. . . .

"The initial attempt resulted in complete failure because of excessive wrinkling. The second attempt at stretch-press forming resulted in tensile failure at the jaws before complete forming was achieved."

Circular form rolling of an external bead stiffener section failed because of excessive wrinkling on the shrinkage portion. Hand-hammered shrink flanges also were not successful. Hand-wrapped elements were successful, but only because the amount of forming was limited to large bend radii.

▶ **Report Conclusions**—After redesign that allowed for forming limitations peculiar to RC-70, successful fabrication of the shrouds was achieved. In general, LaMartine's report concludes: "Formability of RC-70 titanium can be considered similar to $\frac{1}{4}$ hard stainless steel, but the springback is more nearly analogous to $\frac{3}{4}$ hard stainless steel." This material, the report says, should ordinarily be considered applicable to flat sheets, simple brake-formed parts, rubber forming without shrink flanges, shallow ring-type corrugations on cylindrical parts, hand wrappings on large radii, and stretch-formed parts which do not involve metal shrinkage.

Severe springback, anticipated as a

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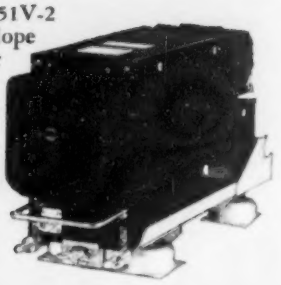
DEPENDABILITY and ACCURACY

Collins 51V-2 Glide Slope Receiver



with the NEW *Collins* 51V-2 Glide Slope Receiver

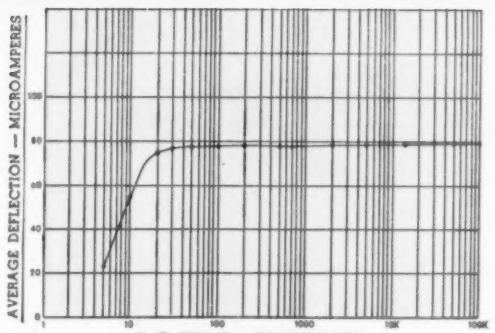
DEVELOPED expressly to meet airline requirements, Collins 51V-2 Receiver together with the Collins type 51R navigation equipment fulfills ILS requirements for commercial and private aircraft.

Negative feedback applied to the two audio stages stabilizes the receiver so that it will perform satisfactorily when the mutual conductance of any or all of the audio tubes is reduced by 50%. AVC voltage on the R.F., I.F. and first audio tubes provides a constant output with varying R.F. input. The AVC characteristic of the receiver is flat from 30 to 100,000 microvolts with standard factory adjustments. These features provide a flat flag current response and allow the flag to be set to very close limits to meet strictest airline requirements. If operating conditions require more or less course softening, a simple screwdriver adjustment of the potentiometer is all that's necessary.

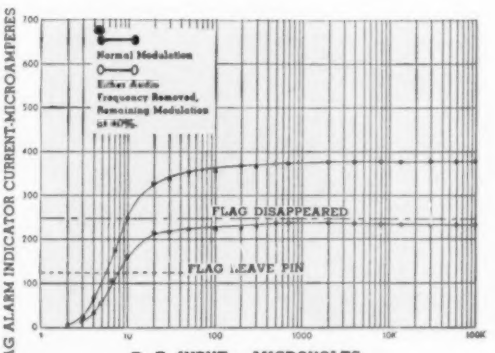
The receiver utilizes a high voltage d-c plate and screen supply obtained from a self-contained dynamotor or 400 cycle a-c power unit. Use of the appropriate dynamotor or a-c power unit makes the receiver operable from a 27.5 volt d-c source or 115 volt, 300-1000 cycle a-c source with 27.5 volts d-c for relays and filaments. The two types of power units are interchangeable.

Another important characteristic is the low value of conducted and radiated interference. Spurious responses are approximately 60 db or more below the level of the desired signal. Precise frequency stability is accomplished through use of a group of twenty crystals for control of the injection oscillator. These crystals are in accordance with MIL-C-3098, except for case marking.

Collins 51V-2 is the successor to the 51V-1, the Glide Slope Receiver noted for its astounding service life. Instrument accuracy of the 51V-2 is unaffected by tube aging. When you install Collins 51V-2, you can be sure of precise instrument approaches for the lifetime of your aircraft.



NORMAL RECEIVER DEFLECTION CURVE — (Falls within limits of ARINC Characteristic No. 519 and RTCA Paper 54-50/DO-33)


FLAG ALARM INDICATOR CURRENT-MICROAMPERES
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knotty problem, proved no obstacle when handled with tools designed specifically for the task, CV says.

Comparing the RC-70 titanium shrouds with stainless steel, Andreoli says they show up favorably in all respects, provide a better weight ratio.

PRODUCTION BRIEFING

► **H&B Machine Co.**, Chicago, Ill., maker of aircraft parts and precision sheet metal products, has acquired the assets of Tyler Machine Co., Culver City, Calif. The 20,000-sq. ft. Culver City plant will be used to make spars, bulkheads, hinges and similar parts for military planes and the facility will be expanded to participate in supersonic aircraft and missile projects.

► **Airwork Corp.**, Miami, Fla., has been appointed distributor for Page Steel & Wire Division of American Chain & Cable Co. and will stock stainless steel and zinc-coated safety wire for plane use.

► **Flex-O-Tube Division** of Meridan Corp., plans to build new production facilities and executive offices on a ten-acre site in Inkster, Mich. Scheduled completion date is April 1954.

► **Electronic Engineering Co. of California**, Los Angeles, has received a contract for more than $300,000 covering design, fabrication and installation of additional guided missile timing equipment at the AF Missile Test Center, Cape Canaveral, Fla.

► **Lockheed Aircraft Corp.** will transfer final assembly and flight test operations of its T-33 jet trainers from Van Nuys to Palmdale, Calif., in May 1954.

► **Schweizer Aircraft Corp.**, Elmira, N. Y., is expanding its work areas 30%, with completion scheduled by April.

► **Ziegler Steel Service Corp.** is doubling the size of its Los Angeles division plant and office. The firm handles steel, sheet, strip, bars and shapes for commercial and aircraft requirements.

► **Temco Aircraft Corp.** has received a contract from Republic Aviation Corp., N. Y., to build "substantial quantities" of F-84F Thunderstreak jet fighter-bomber small assemblies at its Dallas and Garland, Tex., plants.

► **Sikorsky Aircraft Division**, Bridgeport, Conn., has sold an S-55 helicopter to Petroleum-Bell Helicopter Services, Inc., Lafayette, La., for servicing off-shore oil installations. Delivery is for early this year.

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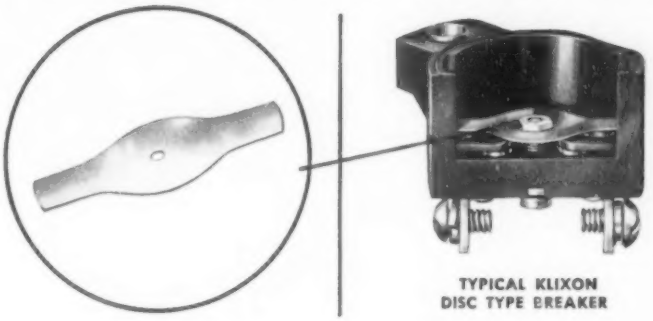

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SIMPLICITY — Only *one* moving part, the Spencer Disc. No complicated mechanisms, such as toggles, latches, magnets or other parts that wear out or lose their calibration.

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Klixon Circuit Breakers are available in a wide range of types and ratings, all sealed types are *explosion-proof, corrosion* and *humidity resistant.*

Write for data which gives complete information.

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PSA Automatic Reset
Ratings: 2 to 35 Amps
Weight: 1 oz.

PDM Manual Reset
Ratings: 15 to 40 Amps
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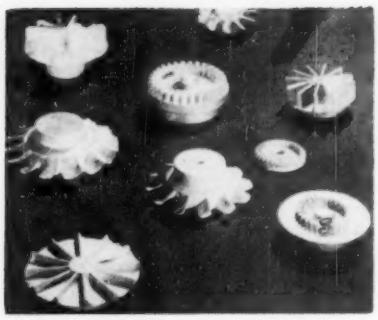


ALUMINUM extrusions for turbine components produced by AiResearch.

Aluminum Extrusion Process Ups Output

An extrusion process for small turbine components has established new production efficiencies at the Garrett Corp.'s AiResearch Mfg. Co., Phoenix.

Aluminum wheels and fans for air cooling, refrigeration, and ram air turbines for commercial and military aircraft are being extruded at the rate of 100 per hour with tolerances as low as .001 in. The fans had been made by hand-duplicating, a four-hour job.

Diameters of the units range from 2 to 4.5 in., with weights spanning 2 oz. to 1½ lb. Some of the units have as much as 10 deep blades, or as many as 30 buckets.

Quality of the new units also is improved, AiResearch says. Extruding changes the grain flow through a radial path straight out to the blade end, for a stronger piece.

The hot extruding is done on a specially designed 1,100-ton Lake Erie press. The machine's ram force of 350 tons is exerted at the rate of 390 in. per min.

In the actual extrusion process, the aluminum slugs are first preheated in an oven, placed in the press die with long-handled tongs, then extrusion in a matter of seconds. Once cooled, the extrusions are sent either to heat-treat or to a machining station, depending upon the alloy.

Machining consists only of work on the bore hub or outer diameter. No contour machining is required.

Record Casting Of Magnesium

The largest magnesium casting ever poured—a base for military avionic equipment—is reported to have been turned out by Rolle Mfg. Co., Lansdale, Pa.

Weighing about 1,630 lb., the outside dimensions of the unit are 114 x 93 x 33 in. Quality control played a big part in the execution of the job. Some

of the quality control checks included tests for moisture content, permeability and sand core strength. Readings were taken from the melt to assure chemical conformation; tensile strength, elongation, yield, hardness and other characteristics were tested. Dimensional checks were followed by Zyglo for surface imperfection detection and X-ray for internal flaws.

Rolle made the huge casting for Western Electric Co., Inc.

BuAer Contracts

The following contract awards of $25,000 and more have been announced recently by the Bureau of Aeronautics, Department of the Navy, Washington 25, D. C.

Alloy Engineering & Casting Co., Champaign, Ill., material & services necessary to acquire, rehabilitate and install, in the contractor's plant at Champaign, Ill., machine tools and other capital equipment required for the production, research and development of high integrity castings, $160,249.

Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J., pneumatic starters, 38 ea., $154,846.

Binks Mfg. Co., Chicago, Ill., construct, furnish and install (2) paint and phenolic resin coating baking systems in the paint and resin coating shop located in the new overhaul and repair bldg. 360 at NAS, Alameda, Calif., $170,894.

Douglas Aircraft Co., Inc., Santa Monica, Calif., demonstrations, $48,233. Services and material for the backfitting required to incorporate master change 1027 (automatic approach system) DS-1192, in Model R4D-8/8Z aircraft, $430,981.

Lockheed Aircraft Corp., Burbank, Calif., kits of parts P/N 433023.3, for installation of AN/APR-9 RCM antenna in P2V-2 and P2V-4 aircraft. Kits of parts, P/N 43302?.6 for affected spares, 95 ea., $36,119.

Norris-Thermador Corp., Los Angeles, Calif., combination rocket launcher, shipping containers for 2.75-in. FFAR Dwgs., engr. progress reports, 200 ea., $80,051.

Trustees of Princeton University, Princeton, N. J., continue investigations to determine basic causes of unstable combustion in liquid rocket engines & establish means for eliminating instability or reducing its undesirable effects. Rpts. $125,000.

United Aircraft Corp., Pratt & Whitney Aircraft Div., E. Hartford, Conn., special tools and ground handling equipment required to support J57-P-2 turbojet engines, $600,000.

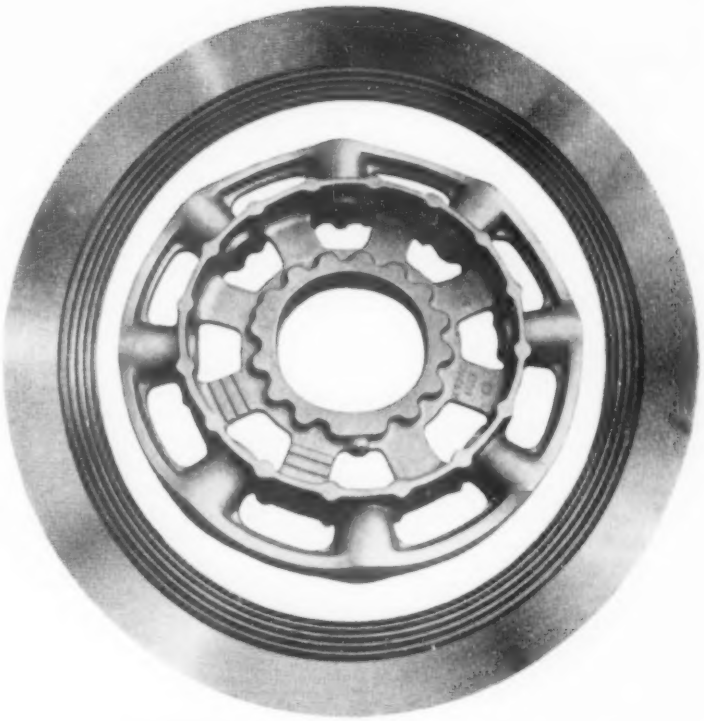
Owens Machine & Engineering Co., Conroe, Tex., services and materials to repair steel furniture and folding cots at Randolph AFB, $25,537.

Robert E. McKee General Contractor, El Paso, Tex., parking apron Biggs AFB, El Paso, $217,337. Rocket storage, Kirtland AFB, Albuquerque, N. M., $121,283.

Skousen-Hise Contracting Co., Albuquerque, N. M., up-range roads Holloman AFB, Alamorgordo, N. M., $289,641.

Hiller Helicopters, skid landing gear modification kits, 42 ea., collective pitch stick stop kit, 42 ea., collective pitch adjustable friction lock kit, 42 ea., quick removable seat deck, 42 ea., cyclic control vibration damper kits, 42 ea., throttle and collective pitch modif. kit, 40 ea., flight control push rod, Group A kit, 12 ea., flight control push rod, Group B kit, 28 ea., service bulletins, $53,313.

Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y., kits of parts for installation of Mk. 54 depth bomb provisions on delivered AF-2S airplanes, 185 ea., $40,490; kits of parts for retroactive installation of the airdriven turn and bank indicator and relocation of the automatic pilot turn and bank indicator in delivered Model AF airplanes, 344 ea., $79,585.

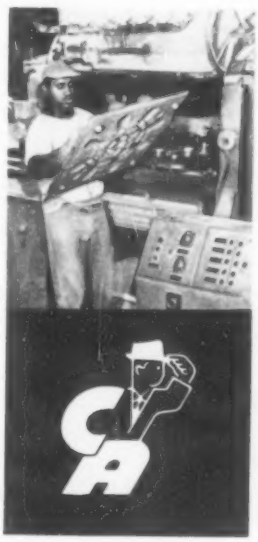


our ring's in the *jet* ring!

The combination of Cooper Alloy centrifugally spun stainless steel jet rings surrounding a Cooper Alloy stainless steel shellcast support ring, clearly illustrates the engineering leadership that has helped us to serve the expanding aircraft industry.

Our thirty years of experience in the high alloy field . . . our intimate association with jet aircraft production, stemming from the very beginning of the jet program . . . our complete control of every step in production, machining and testing, is your guarantee of quality components delivered when you need them.

Bulletin CC-54 tells the story of our association with the aircraft industry. Copies available on request.



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Los Angeles, San Francisco, Oakland, Houston, Chicago, Detroit, Philadelphia, Hartford

Leading producers of STAINLESS STEEL valves, fittings and castings

WHAT'S NEW

Telling the Market

The New Look at North Central Airlines is profusely illustrated picture-and-word story on the airlines' operations since its inception, with emphasis on progress under new management during past year. Write Lake Central at Weir Cook Airport, Indianapolis, Ind.

Facilities and personnel guiding developments of advanced aviation products and techniques undertaken by All American Engineering Co. are covered in booklet. A complete Engineering and Development Service. Write AAEC at Wilmington, Dela.

Rotomotive equipment for aircraft, including jet and piston-engine starters, a.c. and d.c. generators, motors, actuators and integrated electrical control systems, is detailed in Bulletin 6014, distributed by Jack & Heintz, Inc., 17600 Broadway, Cleveland 1, Ohio.

Development and testing and production of aircraft engine accessories by Parker Appliance Co., including devices for fuel, hot air and hydraulic systems, are described in Bulletin 1330-B-1 available from the company at 17325 Euclid Ave., Cleveland 12, Ohio.

Alnico permanent magnet (sintered grade 5) uses, design, properties and manufacture are covered in technical report PM-111 being distributed by Carboloy Dept., General Electric Co., Detroit 32, Mich.

Latest light-metal brazing techniques are comprehensively shown in 22-min. 16-mm. sound film, New Horizons in Aluminum Brazing, offered to industrial firms on loan basis. Write on business letterhead to Motion Picture Section, 854 Alcoa Building, Pittsburgh 19, Pa.

Pure Porous Kel-F, a filtration medium resistant to strong acids, caustics, oxidizing agents and common organic solvents, is described in Brochure T-103, obtainable from Porous Plastic Filter Co., Glen Cove, N. Y.

Dynamometers—Liquid-cooled absorption, motoring, universal and special-purpose—are described and typical installations given in Bulletin DB-1, available from Dynamatic Division, Eaton Manufacturing Co., 3300 14th Ave., Kenosha, Wis.

Paint spray equipment, from connection and spray gun up to air compressors, exhaust fans, water wash paint spray booths and finishing air replacement system, is detailed in catalog being sent out by M&E Manufacturing Co., 25th and Winthrop Ave., Indianapolis 5, Ind.

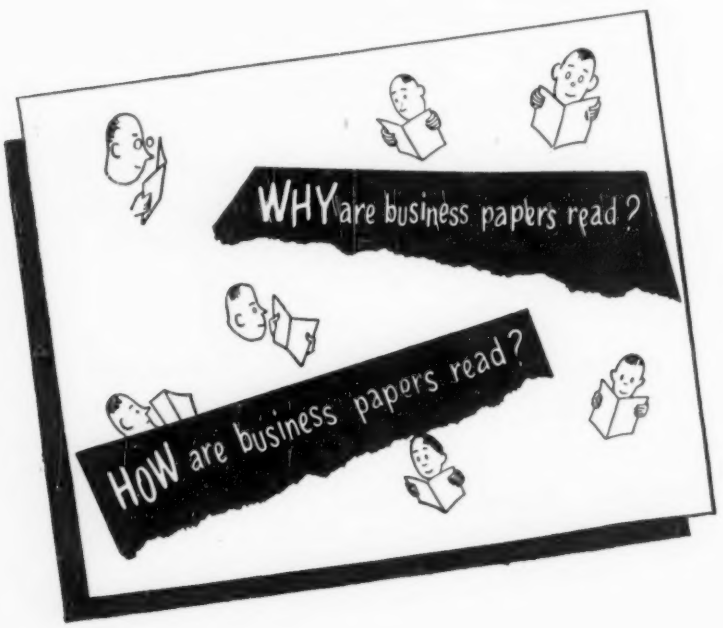
Machines for production gear burring and chamfering are detailed in Bulletin 103-60 being distributed by Modern Industrial Engineering Co., 14230 Birwood Ave., Detroit 4, Mich.

How to Apply Better Zinc Phosphate Coating to Steel in Preparation for Painting is name of a booklet being issued by Oakite Products, Inc., 19 Rector St., New York 6, N. Y.

Portable electric power tools are covered in 40-page Catalog 39-A being issued by Thor Power Tool Co., Aurora, Ill.

Publications Received

- **Filing Manual for Aircraft Correspondence**—by L. P. Bradley, Jr.—pub. by L. P. Bradley, Jr., 2328 Rockdale Ave., Normandy 21, Mo., 256 pp. Outline and suggestions for efficient filing procedures in the field of aeronautics.
- **The Observer's Book of Aircraft**—by Wm. Green & Gerald Pollinger—pub. by Frederick Warne & Co., Inc., 79 Madison Ave., New York, N. Y. $1.25, 287 pp. Data and illustrations of world aircraft for recognition purposes.



A copy of this quick-reading, 8-page booklet is yours for the asking. It contains many facts on the benefits derived from your business paper and tips on how to read more profitably. Write for the "WHY and HOW booklet."

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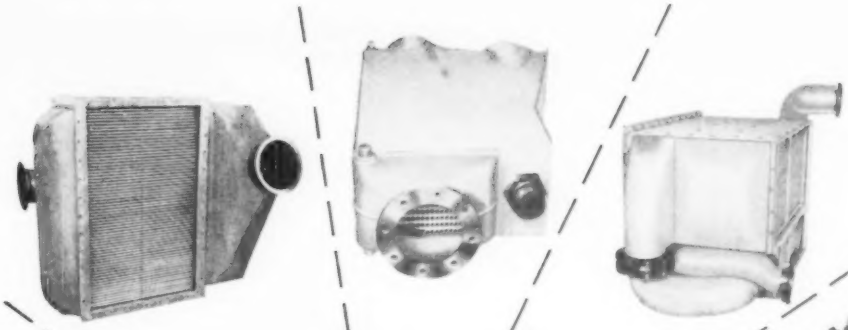
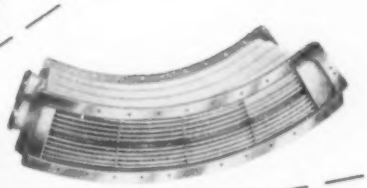


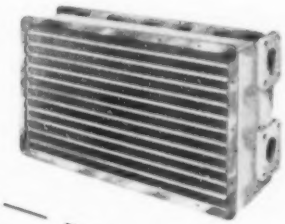
LIGHTWEIGHT, THINWALL

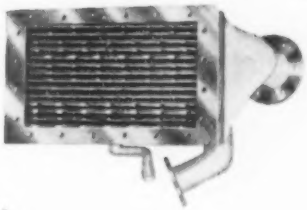
heat exchangers

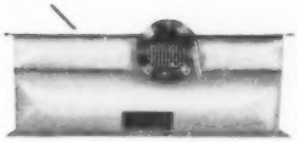
AIR TO AIR

AIR TO LIQUID · LIQUID TO LIQUID









Stainless Steel or Aluminum to meet your specific design needs!

To meet the challenge of higher temperatures in advanced jet engines, South Wind has developed new lightweight, thinwall stainless steel heat exchangers. These heat exchangers fully comply with the rigid specifications set up by airframe and engine manufacturers, as well as the makers of air cycle cooling packages.

In addition to stainless steel, thinwall aluminum heat exchangers also are being designed and fabricated at South Wind for many different applications. Heat transfer from air-to-air, liquid-to-liquid, and air-to-liquid is being achieved effectively with the new South Wind heat exchangers, which utilize either the tube bundle or the plate and fin types of design . . . whichever the job requires.

For Aircraft Heating or Cooling—Pioneers in the field of aircraft heat exchange equipment for providing heat, South Wind has now put that experience to work in the development of heat exchangers for cooling purposes . . . another service to the aircraft industry.

Whatever your need in heat transfer equipment, South Wind's experienced engineering staff will be glad to consult with you. For information, write Stewart-Warner Corporation, South Wind Division, 1514 Drover Street, Indianapolis 7, Indiana.

South Wind

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AIRCRAFT HEATERS
HEAT EXCHANGE EQUIPMENT
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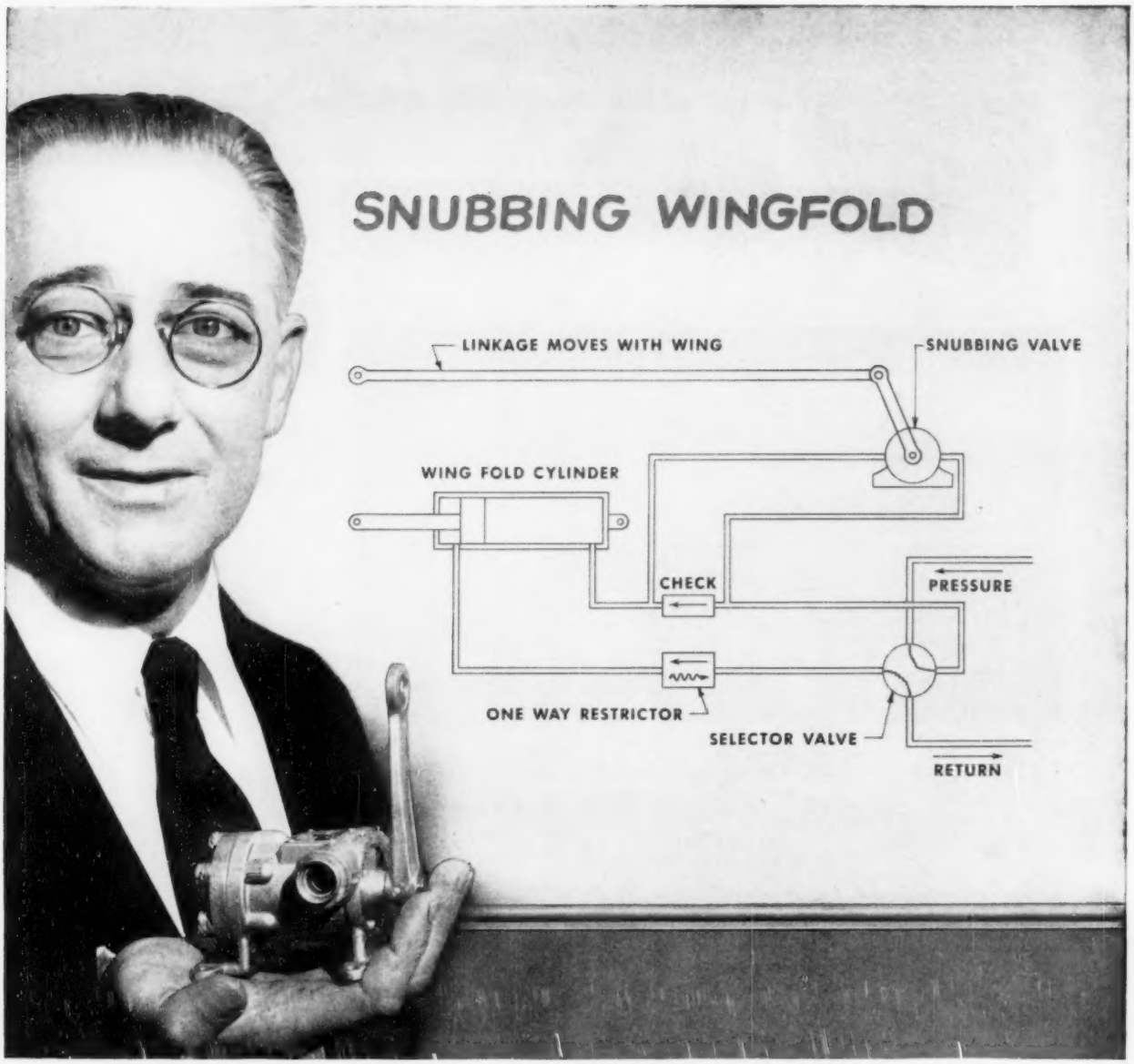
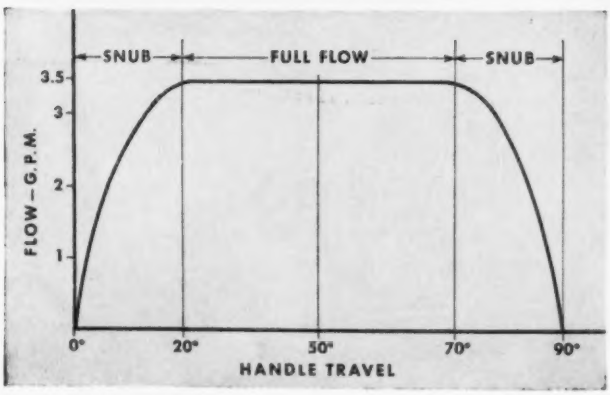
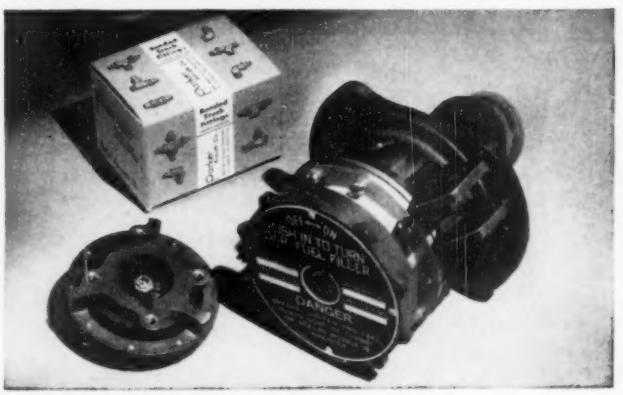




Flow vs. handle travel at 60 psi. maximum pressure drop shows how new Parker shear-plate valves provide fine metering at each end of the plate travel.



What other Parker components for hydraulic and fuel systems interest you? Parker Aircraft Co. builds a wide variety of products for many different applications.

Adaptability of new Parker valve helps simplify hydraulic-system design

"Many hydraulic-system designs can now be simplified by using Parker's new line of shear-plate valves. One basic valve can easily be adapted for landing gear, bomb-bay doors, fairing doors, or wing folding," reports H. C. Trich, shown at left describing a wing-fold application. He is Staff Engineer—Hydraulic Systems, at Parker Aircraft Co.

"Parker's shear-plate valves are also intriguing to designers," he continues, "because they can provide the best snubbing available. This snubbing is the result of metering at each end of the plate travel . . . made possible by the tear-drop shape of the ports.

"These valves all have inherently low leakage because of the metal-to-metal seal between the plates. The plate surfaces are optically flat within two light bands. Because there is never any separation of the plates, contaminant cannot get between the surfaces to cause leaks. There is also no uncontrolled interflow between the ports.

"You can order shutoff, 3-way or 4-way Parker shear-plate valves for various applications and they're available for pressures up to 3000 psi., with either electrical or manual operation.

"Why not familiarize yourself with all the features and benefits offered by this valve. Just fill out the coupon and mail it today."

* * *

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Hydraulic and fluid system components

Speed your inquiries for aircraft valves and fittings by addressing everything to Parker Aircraft Co. Both sales and engineering are now at this one location.

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Please send me the following information:

☐ Information about Parker's new shear-plate valves.

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NAME _____ TITLE _____

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Mail this coupon today! Be sure to check the information desired. If you have questions about any other products, please write to Parker at the address shown above.

tested and PROVED

Recently at Air Force Flight Test Center, Edwards Air Force Base, a *Beechcraft* designed and produced T-34A trainer completed important flight testing during which 434 flying hours were logged in 32 days. So far as is known, this is the shortest length of time on record used to complete such tests – all the more to the credit of both the Beechcraft T-34A Mentor and the military test crews.

As a part of that testing, one USAF T-34A was flown continuously for a 24-hour period with only 40 minutes out for seven landings to take on fuel. The seven "pit-checks" averaged out to 5 minutes and 42 seconds each – a tribute to the plane, its pilots. and the ground crews.

The performance-record was not just a "stunt" – it was carried out in the functional development part of the series of tests all USAF aircraft must go through in order to become an accepted part of the nation's air defenses; it was carried out to know if the T-34A could stand up under a round-the-clock training program.

The Beechcraft T-34A trainer is now *in production* for the U. S. A. F. and the military services of friendly foreign governments.

Beechcraft

Beech Aircraft Corporation, Wichita, Kansas, U. S. A.

Beech Builds: USAF T-34A • USAF L-23A • USAF C-45H • USN SNB-5 • Model 35 Bonanza • Model 50 Twin-Bonanza • Model 18 Executive Transport

Market Fluctuations of Major Airlines

Carrier	1953 Range		Close		Change	Percent Decline	Book Value[1]
	High	Low	Dec. 31, 1952	Dec. 31, 1953			
American	15⅜	11⅜	14¾	11⅜	− 3⅜	22.8	$8.90
Braniff	11⅛	6⅞	10⅛	6	− 4⅛	40.7	10.00
Capital	13½	8½	11⅞	8⅝	− 3¼	27.3	13.92
Colonial	14½	10¼	12⅝	11½	− 1⅛	8.9	4.0
Continental	8⅞	6½	7½	6¾	− ¾	10.0	9.25
Delta—C&S	32	19½	29½	19½	−10	33.8	26.00
Eastern	28⅜	20⅝	26¼	22⅜	− 3⅞	14.7	21.50
National	15½	11⅜	14¼	13⅜	− ⅞	5.9	15.00
Northwest	14½	8½	13¼	8½	− 4¾	35.8	18.00
Northeast	4¼	2⅝	4½	4½	+ 3/8[2]	+ 9.0[2]	4.25
Pan American	11⅝	8¼	9⅝	9¼	− ⅜	3.8	16.50
TWA	20¼	12¾	17⅝	12½	− 5	27.9	16.50
United	32¼	21¼	29½	21⅜	− 8⅛	27.5	27.75
Western	12⅝	8⅝	10¾	8¼	− 2	18.6	13.75

[1] Per common share, estimated as of Dec. 31, 1953.
[2] Increase.

Investors Wary of Airline Stocks

Despite sustained earnings, uncertainties prevailing in air transport outlook push equity prices down.

Stockholders of air transport companies fared badly in 1953, as their equities showed considerable decline in market prices. This was despite sustained and, in some cases, new peak earnings for carriers during the year.

There was a moderate improvement in quotations for a number of airline equities by the end of January 1954, in keeping with a strong general market. But, while the improvement last month in industrial stocks (as measured by the Dow-Jones averages) wiped out most of their 1953 decline, the airline group has thus far not experienced anywhere near a similar price recovery.

▶ **Only One Rise**—The exclusive AVIATION WEEK compilation above reveals the 1953 fluctuations of the common stocks of all U. S. major air carriers. It can be seen that 13 out of the 14 issues declined. Price depreciations ranged from 3.8% (Pan American) to 40.7% (Braniff).

Northeast Airlines alone showed an appreciation—9% for last year. This counter action to the industry's declining experience may be largely technical in view of the fractional fluctuation premised on a low base quotation. Still the fact remains that Northeast's management has demonstrated a first-rate operational record with a difficult route structure heavily dependent upon subsidy.

▶ **Better in 1954**—Pan American not only was the lowest of the losers with its 3.8% drop, but since the new year the equity has registered a major percentage recovery. The basis for the recent improved action may be found in the expectation of much better earnings to be reported for 1953. This can be anticipated by the higher dividend declarations late in 1953 and early 1954. The recent 20-cent-per-share declaration, while not indicated as a quarterly disbursement, was regarded as such by many. This followed the 40-cent-per-share semi-annual payment in December, as compared to 25 cents in prior years.

Among the trunklines, National's common stock showed the best resistance to a price decline during 1953, off only 5.9%; it later wiped out its entire 1953 market loss during the month of January 1954. Excellent earnings through operations and capital gains are being established by National and can hardly be ignored.

▶ **Merger Effect**—The Colonial price fluctuations are without significance to any inherent position of the company. Colonial and the price of its equity are influenced almost exclusively by the outlook of its pending merger proposal with Eastern.

Braniff's equity took the sharpest decline for 1953, off 40.7%. This is nothing more than a reflection of the substantial losses experienced in its domestic service (through Mid-Continent) and of its Latin American routes. The carrier's recent petition for a material increase in its domestic mail pay is an indication of the seriousness of the deterioration of earnings from such operations.

▶ **Too Many Disappointments**—There is no doubt that the airlines have lost a good deal of investment support in recent years. No longer are future prospects given liberal evaluations in the market place. There have been too many disappointments of past expectations of airline results to kindle strong enthusiasms for the recent manifestation of sustained earnings.

From the accompanying table, it can be seen American and Colonial are the only equities to command a substantial market premium over book values. The high degree of leverage present in American's capital structure along with good earnings accounts for the condition prevailing there.

During the industry's earlier years, market premiums of many times book values were not uncommon. An almost complete reversal of this phenomenon has now taken place. Airline equities not only now sell at their lowest relation to book value but also at the lowest levels to their anticipated earnings—which is always the most controlling element.

▶ **Earnings Trail Growth**—The air transport industry has experienced tremendous growth—even greater than that predicted by many sources. But earnings have not at all matched the gains in traffic development.

As noted here previously (AVIATION WEEK Nov. 16, 1953, p. 45), "Shifting governmental policies confuse investors and give rise to many doubts as to stability in the industry. The highly marginal aspects of operations, where rising costs and lowering unit revenues pose a real threat to earnings, are not conducive to attracting potential investors.

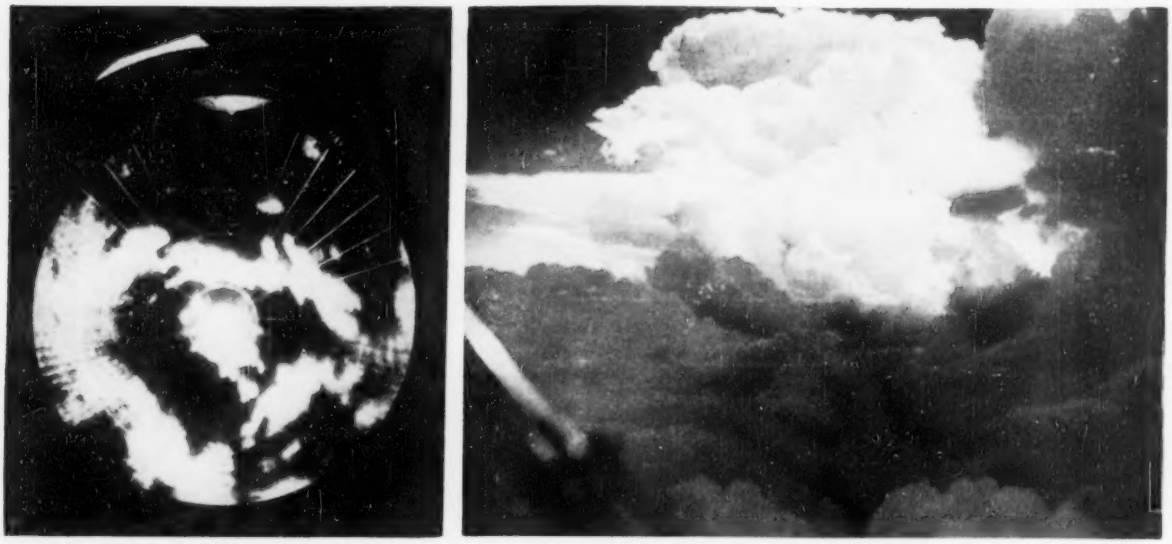
"The need for husbanding financial resources to acquire constantly growing facilities has made for limited dividend disbursements. This is not viewed favorably by many would-be investors."

The recent Supreme Court decision on offsetting mail pay subsidies through all other income is still another example of the unsettling influences confronting air carriers still dependent on mail pay subsidies. And there are many in this category.

▶ **Opportunity for Investors**—The wide disparities in market fluctuations of airline equities, as for aircraft shares, demonstrates the highly selective nature of the aviation industry.

Market quotations for airline securities have been known to swing from one extreme to another—first taking a too liberal view of the future and then too dark. A process of "over-discounting" may be taking place now. Future earnings of the separate airlines will tell if this is so.

—Selig Altschul

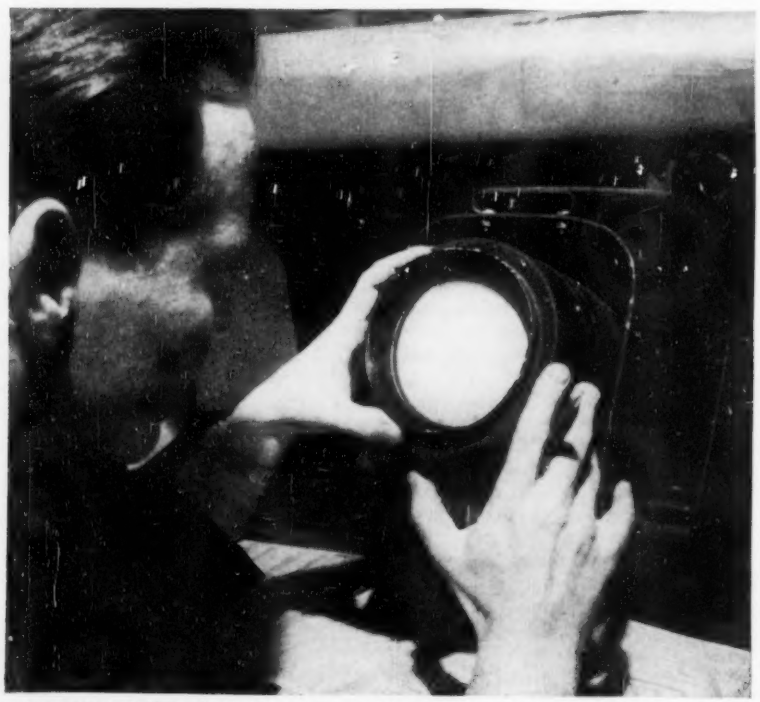


PILOTS ARE ENTHUSIASTIC about airborne radar, which not only spots storms, but can pick non-turbulent paths through them.

Split on Wavelength Spurs Radar Race

X-band or C-band? Experts disagree about relative advantages of each for airborne storm-warning units.

By Philip Klass



EXPERTS AGREE about the value of airborne radar, don't agree about wavelength.

A split in the airline and avionics industry over the best wavelength for airborne radar is sparking, and will undoubtedly accelerate, the race to develop suitable storm-warning equipments.

The older X-band (3.2 cm.), widely used by the military, and the newer C-band (5.7 cm.) radars each have their relative advantages and disadvantages. An airline's decision on which to buy will consider such factors as comparative ability to penetrate heavy rainfall; to find non-turbulent paths through storms; reliability; price and size.

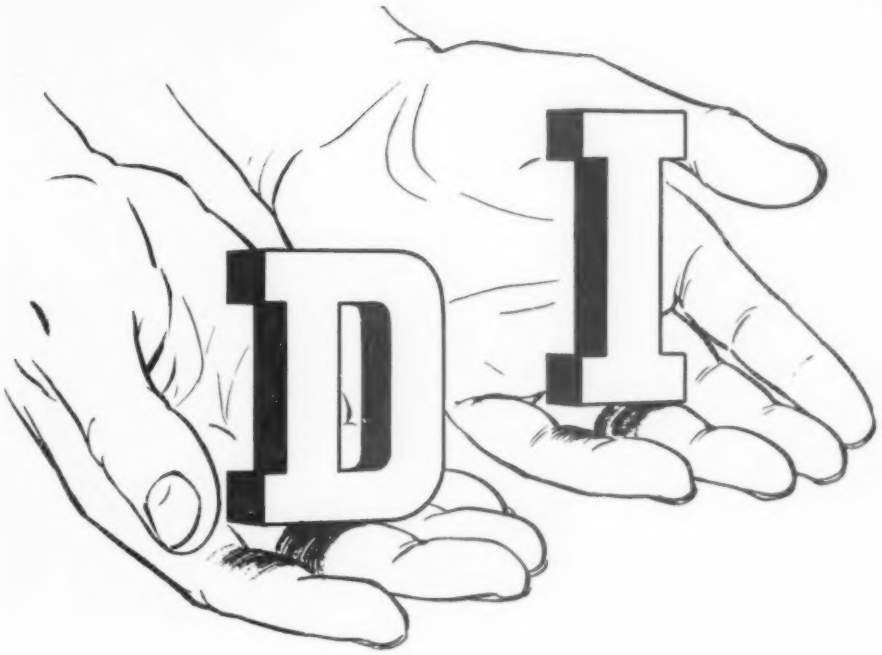
Two avionic manufacturers have committed themselves to the race, each to a different band:

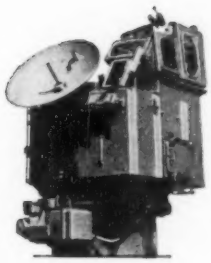
• **Radio Corporation of America** is designing a C-band radar, reportedly expects to fly a prototype in less than 15 months, be in production within two years.

• **Bendix Radio** says it will fly a prototype X-band set this spring and expects to have limited production units before the end of the year.

▶ **Who's Where**—In airline circles, United is the strongest proponent of C-band, following its flight tests of an experimental RCA C-band radar last summer in a DC-3 (AVIATION WEEK Dec. 28, p. 7).

UAL's director of communications, J. R. Cunningham, says: ". . . it is our considered opinion that C-band radar





Skilled hands

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AIRBORNE EXPLORER—Rugged dependability of Sikorsky helicopters in wilderness operations is again being demonstrated in northern Canada, this time by Hudson Bay Mining and Smelting Co., Ltd. Here the company's big S-55 is unloaded on a narrow ledge at 6000 feet, where crews are making an extensive geophysical survey.

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ARCTIC ANGEL—Greenland Eskimos, displaced 80 miles further north by the air base at Thule, are aided by Danish technicians flown in by Sikorsky helicopter. Such mercy missions are routine for Thule-based Air Force H-19s, which have flown as far as 200 miles into the icy Arctic wastes of Greenland on daring rescue flights.

INTERNATIONAL SERVICE—Airline passengers whose transatlantic flights begin or end at Brussels can now have the additional advantage of SABENA Belgian Airlines' international passenger helicopter service, in big S-55s, from Brussels to Antwerp and Rotterdam; to Liege, Maastricht, Cologne and Bonn; and to Lille.

NEWEST SERVICE—A big Sikorsky S-55 is the newest aircraft to join the National Airlines fleet. The 10-passenger helicopter currently is based in the Miami, Florida area, headquarters of the airline's North-South trunklines. National's Sikorsky is the first large helicopter thus far put into operation by a major scheduled American passenger airline.

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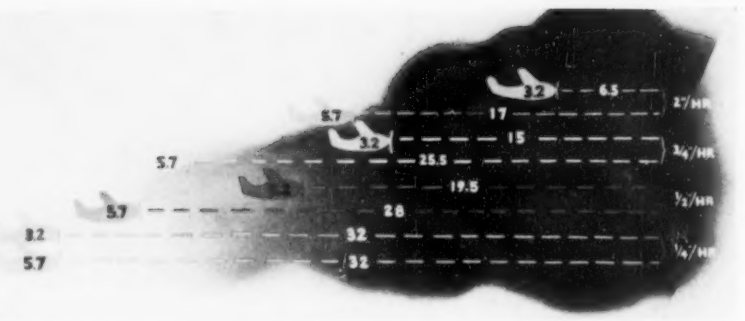

COMPARISON OF PENETRATION of light, medium and heavy rainfall by 3.2-cm. and 5.7-cm. radar is based on study by two McGill University scientists.

is the optimum for airborne weather mapping purposes."

The characteristic (spec) for weather warning radar, recently approved by the Airlines Electronic Engineering Committee of Aeronautical Radio, Inc. (Arinc), specifies C-band. However this decision was reached only after lengthy debate and there is the possibility that AEEC will draw up another spec for a 3.2-cm. (X-band) "general-purpose" airline radar.

AEEC's choice is based on the results of UAL tests and an Arinc-ATA sponsored study, using certain simplifying assumptions, by Drs. J. S. Marshall and Walter Hitschfeld, weather radar experts at McGill University. Earlier studies conducted by David Atlas and Howard Banks, of the AF Cambridge Research Center, showing that attenuation in heavy rainfall can seriously distort the true depth of a storm on an X-band radar, were also a factor.

However, in recent conversations with AVIATION WEEK, Atlas says that C-band's inferior definition leaves him in doubt as to whether it is a better frequency for airline needs.

► **Airline and Military**—American Airlines, whose extensive postwar radar tests for the Navy led to the 3.2-cm. AN/APS-42 radar presently used in many Navy and MATS aircraft, is on the fence, as are most other airlines.

Navy and Military Air Transport Service spokesmen, while taking no official stand on the question, have shown considerable interest. They use their APS-42s for both navigation and weather warning, point to more than 50,000 flight hours with no kicks on X-band performance in navigating through and around thunderstorms.

► **Concessions and Disagreements**—Both sides are generally willing to concede certain advantages to the other. The controversy comes over the question of "how much better" or "what does it really buy you?" For example:

• **Rainstorm penetration.** Both camps agree that C-band is better able to penetrate heavy rainfall, but disagree on what percentage of the time an airline must thread its way through such storms, what percentage of the time it can circumnavigate completely around them. When there is little or no intervening rain, X-band radar has greater range.

• **Definition.** Both sides agree that X-band inherently has better definition (narrower beamwidth) enabling it to spot smaller-non-turbulent paths through a storm. However, Frank Todd of UAL reports that the experimental C-band set which United tested with a 22-in. antenna gave adequate definition of nonturbulent paths. Most of the newer airliners, except for the DC-6, 7, should be able to accommodate larger antennas, giving C-band improved definition.

• **Weight, size and price.** It is generally agreed that X-band radar will be smaller, lighter, and less expensive than C-band. Whether this difference is "insignificant" or "appreciable" is a bone of contention.

► **Sharp Disagreement**—There is sharp disagreement over the best choice from the standpoint of extreme equipment reliability, which the airlines insist upon. An X-band radar, its proponents say, will use components which have been proven and "de-bugged" in military service, whereas C-band will require development of a new magnetron and TR (transmit-receive) tube which must get their first shakedown in airline use.

C-band proponents say this is an advantage and should result in greater reliability because components will be conservatively designed for maximum reliability, instead of trying to squeeze out the last ounce of performance, as is frequently done with military radars.

► **X-band vs. C-band**—There is only one known instance where a C-band radar has been pitted against an X-band set to compare their performance. This occurred last August when an APS-42-equipped Navy R5D found itself in the vicinity of Denver and joined the UAL radar-equipped DC-3 in a thunderstorm probing expedition.

The test was an informal one, ar-

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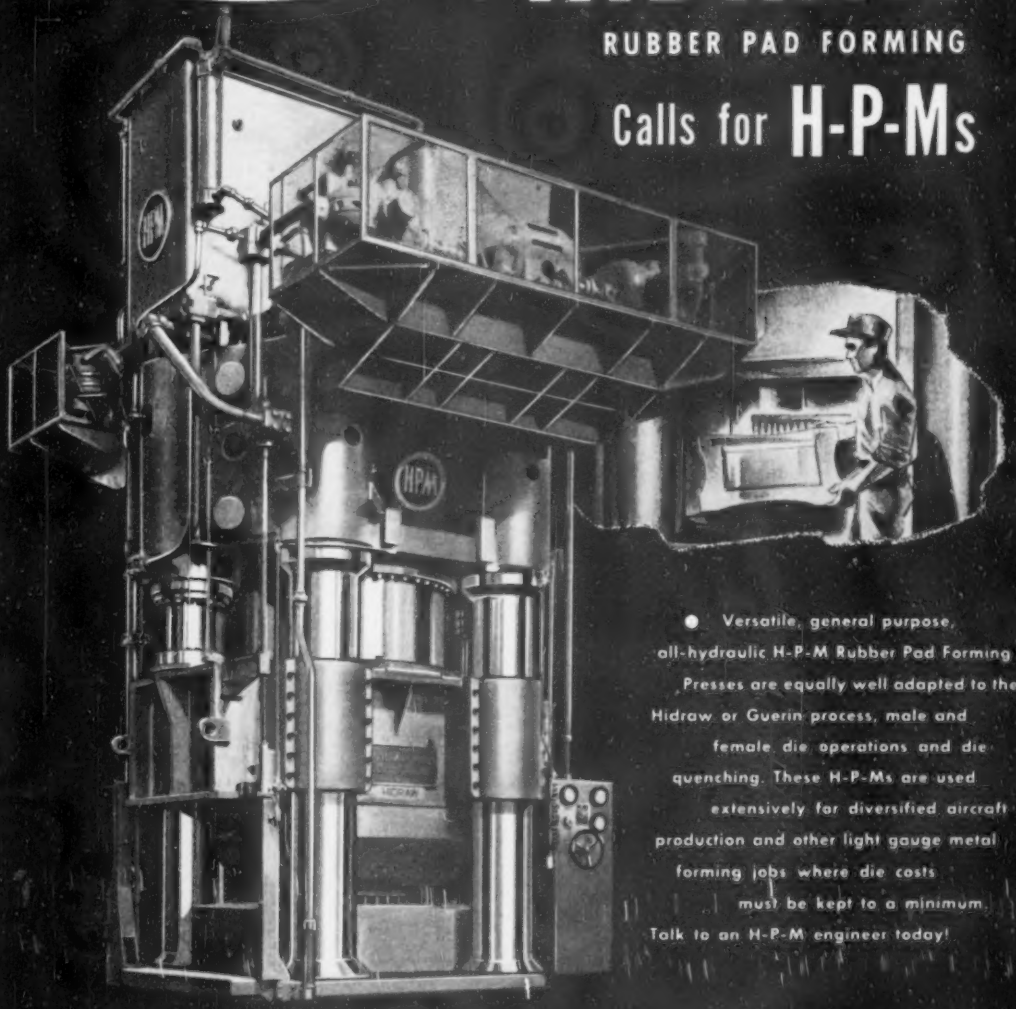

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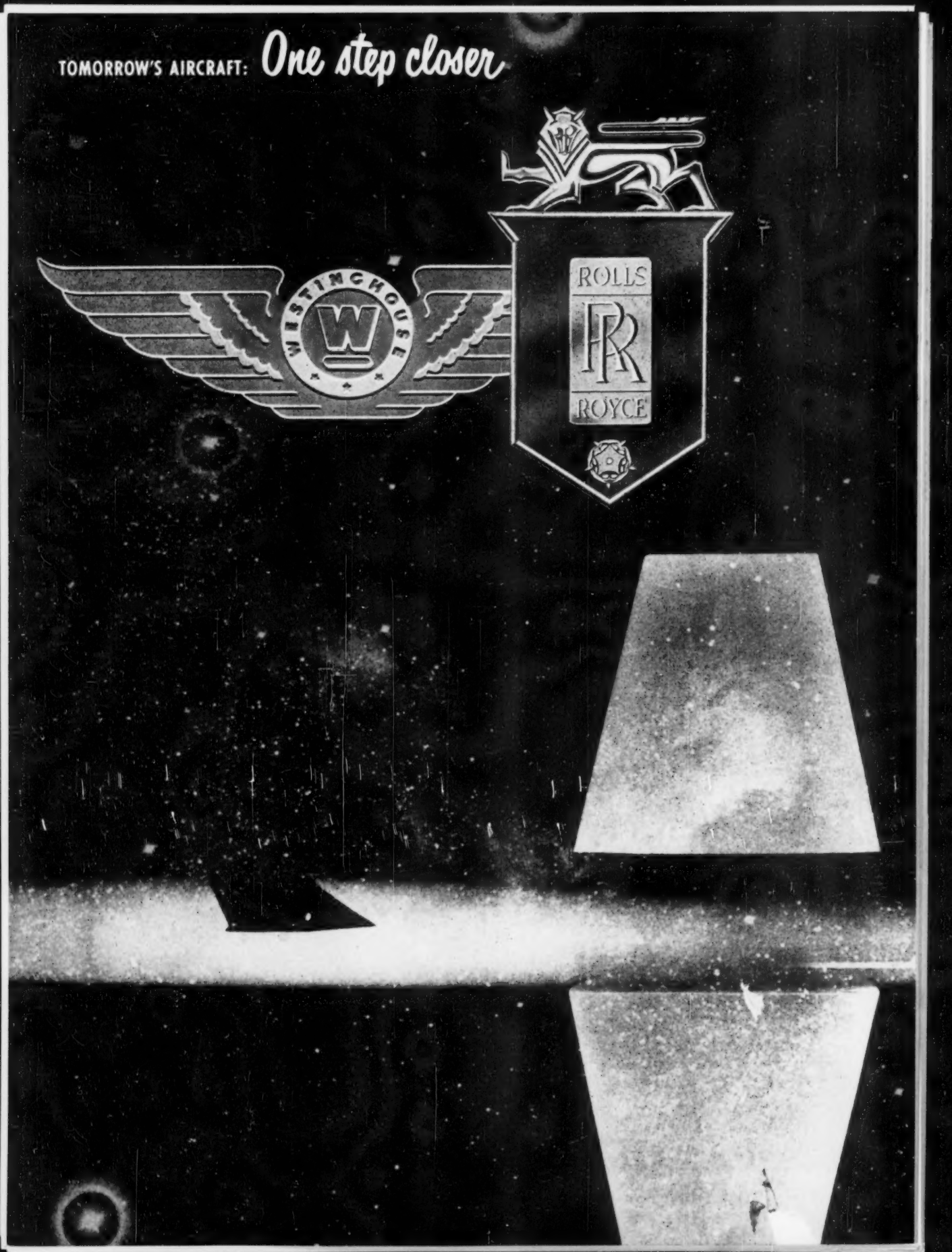
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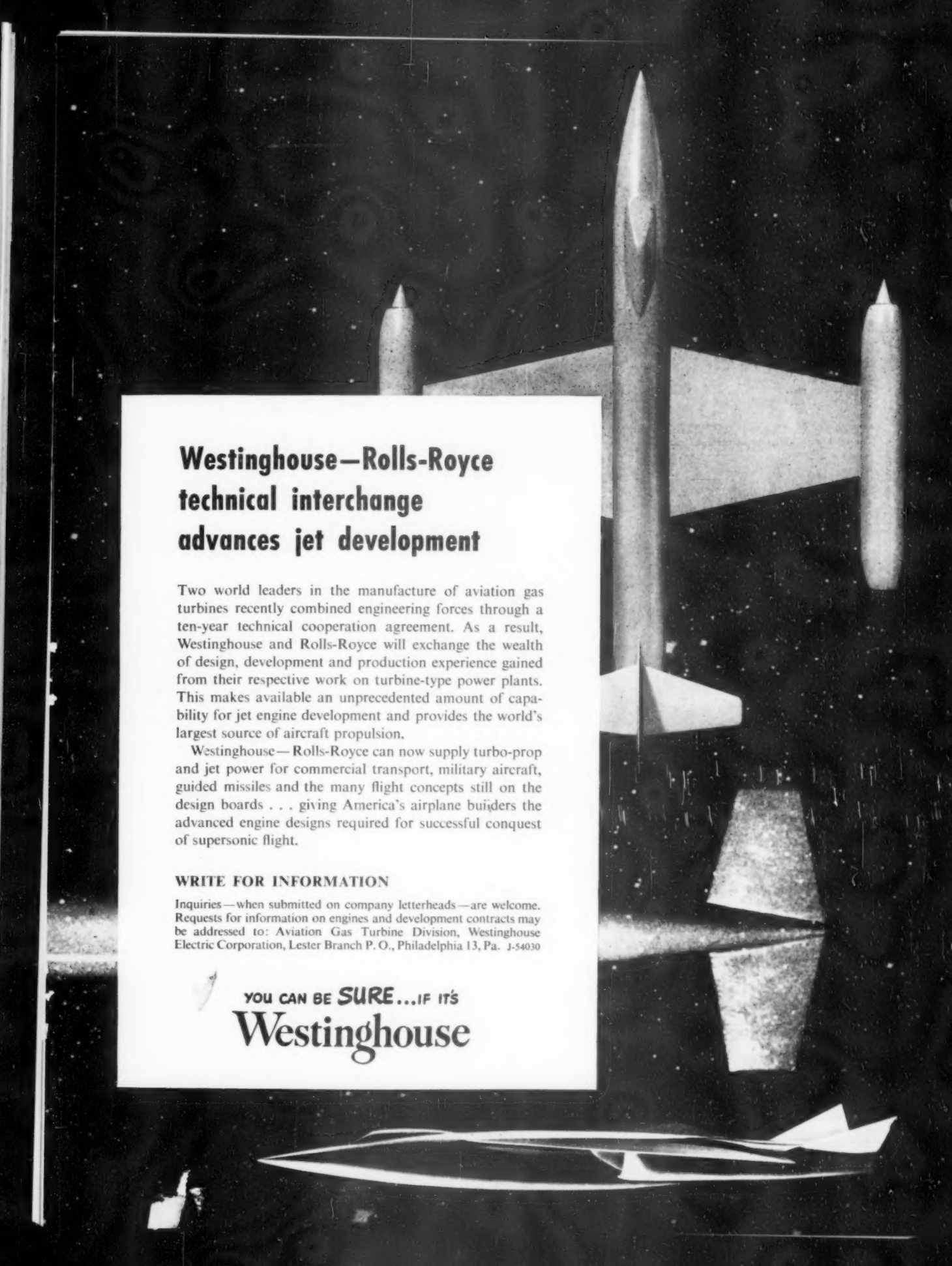

Westinghouse—Rolls-Royce technical interchange advances jet development

Two world leaders in the manufacture of aviation gas turbines recently combined engineering forces through a ten-year technical cooperation agreement. As a result, Westinghouse and Rolls-Royce will exchange the wealth of design, development and production experience gained from their respective work on turbine-type power plants. This makes available an unprecedented amount of capability for jet engine development and provides the world's largest source of aircraft propulsion.

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By investing its own funds in the development of a jet transport, Boeing is providing an advantage that will be shared by future purchasers. Design and construction of this prototype now will make possible the building of production airplanes at an earlier date. It will also afford an early opportunity to prove out engineering, production and operational details. This prototype has behind it the thousands of hours of research and flight experience Boeing has gained with the B-47 Stratojet and the eight-jet B-52 Stratofortress.

This background of experience with large, multi-jet aircraft is unmatched anywhere in the world, and is a vital part of Boeing's 37-year history of pioneering successful new types of airplanes. You can depend upon the integrity of Boeing research, design and engineering to make the coming prototype an aircraft that will contribute greatly to the new jet age of flight.

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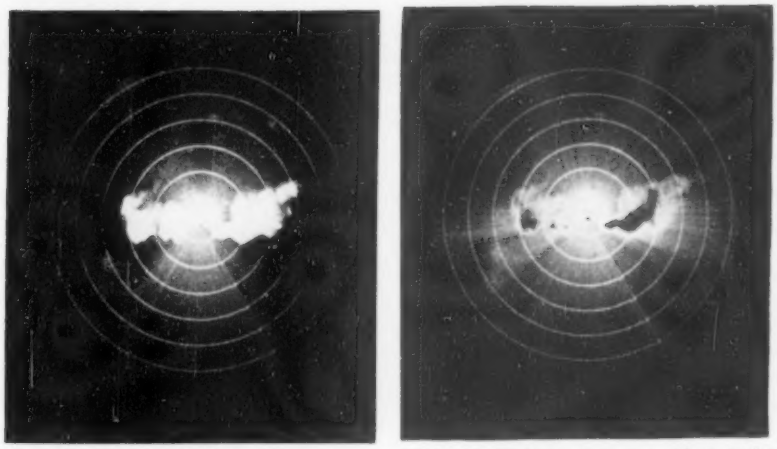

ISO-ECHO CONTOURING effect shows most intense portions of storm in black (right photo). Nearly simultaneous picture at left is of storm without iso-echo contouring.

ranged on short notice. Observers in each aircraft tried to take simultaneous photos of their radar scopes for later comparison. However, one airplane ended up with more radar scope photos than the other, making it difficult to correlate the two sets of photos, AVIATION WEEK was told.

▶ **Conflicting Reports**—Despite the fact that C-band and X-band proponents were divided so there were some of each on both aircraft, there is considerable disagreement on what happened, what they saw, which set proved superior.

It is unfortunate that additional comparative tests, with improved interplane coordination, were not arranged at the time. UAL has since removed its experimental radar from the DC-3.

United has completed its lengthy analysis of last summer's tests and will shortly release a detailed report, containing some 4,000 radar scope photos. Until this report is out, the industry has Cunningham's official statement: "Data accumulated during our evaluation program proved conclusively that C-band radar will penetrate a minimum of 15 miles of 60 mm./hr. rainfall using a transmitter power of 75 kw. . . . Our detailed study . . . indicates that this performance cannot be duplicated practically by equipment operating on a higher frequency."

▶ **Root of the Controversy**—The physical characteristics which enable radar to "see" thunderstorms are what produce the present controversy. When radar energy strikes raindrops, some of it is absorbed, some is scattered. That portion of the scattered energy which is reflected back to the radar antenna produces, in this case, the desired storm echo on the scope. The absorbed energy, and scattered energy which doesn't return to antenna, weaken penetration of the radar beam through the rain. When radar is used for storm warning, these factors work against each other.

Thus a low-microwave-frequency (long wavelength) radar penetrates storms with practically no scattering, hence does not "see" them. A high microwave-frequency set gets a good strong return from the nearest edge of the storm. However, as the signal penetrates the storm, it is attenuated so that far side of storm may not show up, distorting the true storm depth.

▶ **Limited Agreement**—There is no disagreement on these fundamentals, nor that some medium microwave frequency, which will optimize echo return while minimizing attenuation, is desirable for an airline radar designed primarily for weather warning. The question is whether X- or C-band is the better compromise frequency.

Frank White of the Air Transport Assn. originally spearheaded the movement for a lower-frequency radar as a result of his experience as project engineer on American Airlines' postwar radar tests. During these, and subsequent Navy tests in which he participated, he found instances where the airplane required considerably longer to traverse a storm than the radar indicated that it should.

After an investigation, and study of the Atlas-Banks analysis, White concluded that this discrepancy between radar display and reality was caused by attenuation of X-band energy, i.e., no echo was received from the far side of the storm.

In September 1950, White proposed a shift to 5.7 cm., in a paper delivered before the Radio Technical Commission for Aeronautics, Radio-Television Manufacturers Assn., and Institute of Navigation. White felt that the new frequency, which had earlier been allocated for aviation use, was a better compromise.

It is interesting to note, however, that storm-depth distortion did not appear to be a major problem or serious

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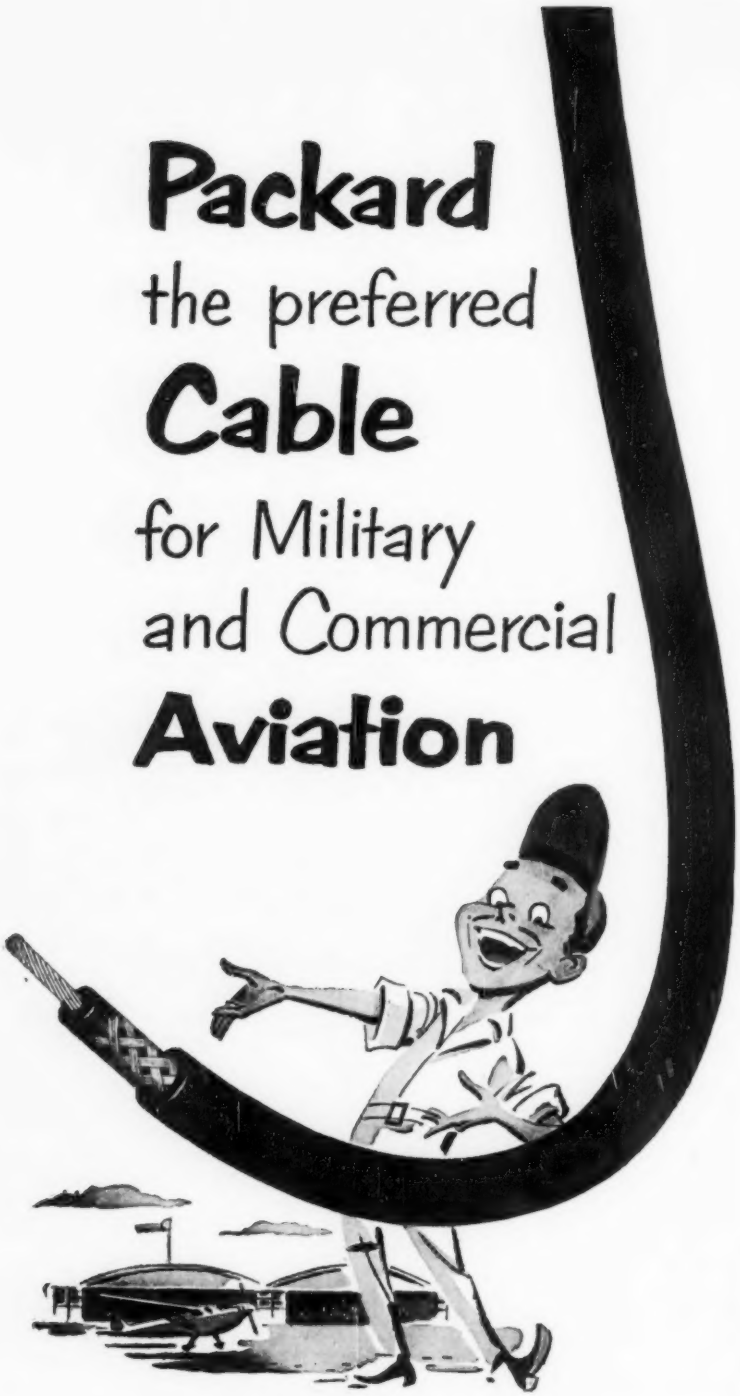

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shortcoming at the time of AA's tests for the Navy, despite the very low power (8-10 kw.) of the radar used. In the final report, dated September 1949, there is no mention of serious 3.2-cm. shortcomings when used for storm avoidance.

▶ **Not Alone**—White, however, was not the only one to conclude that 5-6 cm. might be a better band for weather radar. Speaking before the British Institution of Radio Engineers, Feb. 20, 1952, on the subject of airborne storm-warning radar, P. L. Stride of E. K. Cole, Ltd., British radar manufacturer, concluded:

"The path attenuation is also important if the desired target is hidden in other heavy clouds and when it is desired to see the far edge of the storm area. Taking these factors into account leads to the conclusion that a wavelength in the region of 5-6 cm. is the most favorable."

▶ **Study and Report**—To obtain a quantitative comparison of the two wavelengths, ATA and Arinc sponsored the study by Dr. Marshall and Dr. Hitschfeld.

Their report, issued last February, makes no attempt to consider such factors as equipment size, weight, price, relative reliability or operational use. It compares the performance of the two bands, making certain simplifying assumptions and basing calculations on parameters, such as radar power and antenna size, specified by ATA and Arinc.

The report shows that C-band and X-band radars (with powers and antenna sizes currently planned) have the same range when there is 200 mm./hr.-miles of rain (product of rainfall rate and distance over which it extends) between the radar and the target (storm). With more than 200 mm./hr.-miles of intervening rain, C-band has much greater range; with less intervening rain, X-band has the edge.

The report adds: "A frontal line of showers is likely to involve . . . a few hundred mm./hr.-miles of rain, probably, though not certainly, less than 500."

▶ **Storm Intensity Contours**—The report does not deal with another adverse factor caused by radar attenuation, that of storm-intensity distortion when iso-echo contouring is used. There is considerable evidence that the turbulence within various parts of a thunderstorm is determined by rainfall gradient (rate of change of rainfall rate with distance) rather than by rainfall rate itself.

To show the pilot varying rainfall gradients, an iso-echo contouring technique is used, which causes extremely heavy rain to appear on the radar scope as black areas instead of bright areas. This gives a picture in which the very heavy rain areas (black) are surrounded

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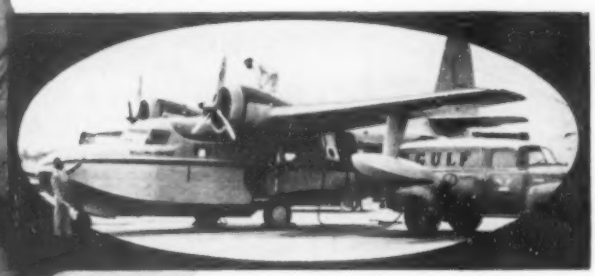

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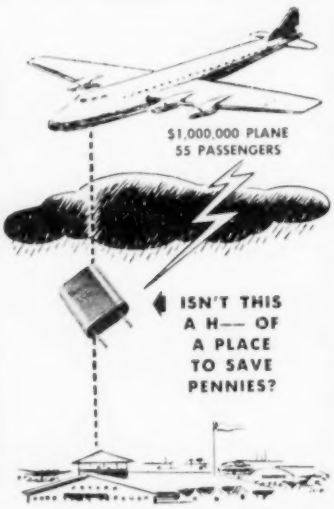

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by bright echos from light rain, which are in turn surrounded by black no-rain areas. Wherever the light-rain echo areas are thinnest, the rainfall gradient is high because the distance from no rain to extremely heavy rain is short.

X-band's greater attenuation will cause it to distort storm-intensity contours. This, combined with its tendency to shorten the apparent depth of a heavy storm, might lure a pilot into taying to traverse a storm front at the wrong place, C-band proponents say.

▶ **Spotting Safe Paths**—X-band supporters counter this argument by pointing out that for same antenna size, 3.2 cm. gives almost twice as good definition as 5.7 cm., thus will be able to spot thin non-turbulent paths through a front which the C-band set will never see.

For example, unless some way is found to get a larger antenna into the DC-6 and DC-7, a C-band set will have a beam width of 7½ degrees (between half-power points). At a distance of 20 miles, this beam is almost three miles wide so that a non-turbulent path only one mile wide between storm cores probably would not show up on a C-band radar at that distance.

However, Frank Todd says that paths less than a mile wide were seen with UAL's C-band set, using a 22-in. antenna. By reducing receiver gain (sensitivity) it is possible to obtain very adequate definition, Todd reports.

Despite this reassurance, it is noteworthy that David Atlas, whose original work pointed up the attenuation shortcomings of X-band, is equally concerned over C-band's poorer definition. Atlas told AVIATION WEEK that he found it difficult to evaluate the relative importance of each shortcoming.

▶ **Navigation Use?**—X-band's better definition gives it the edge for ground mapping (navigation aid).

However, most airline spokesmen say that the equipment will be used almost solely for weather surveillance. Others reply that once airline pilots start using radar, they will want to employ it as a navigation aid, regardless of what airline engineers and management now think.

In any event, a United spokesman reports satisfactory ground mapping with C-band.

▶ **Weight, Size, Price**—Larger waveguides, a higher power magnetron (75 kw. vs. 40 kw.) and possibly a larger antenna (to give comparable definition) will make the C-band set somewhat larger and heavier. Estimates of X-band's weight advantage vary from 10% to 50%, with size advantage somewhat less. When compared on the basis of total installed weights, X-band will probably have only a slight edge.

Despite the fact that Bendix is quoting a price of $14,750 and RCA is talk-

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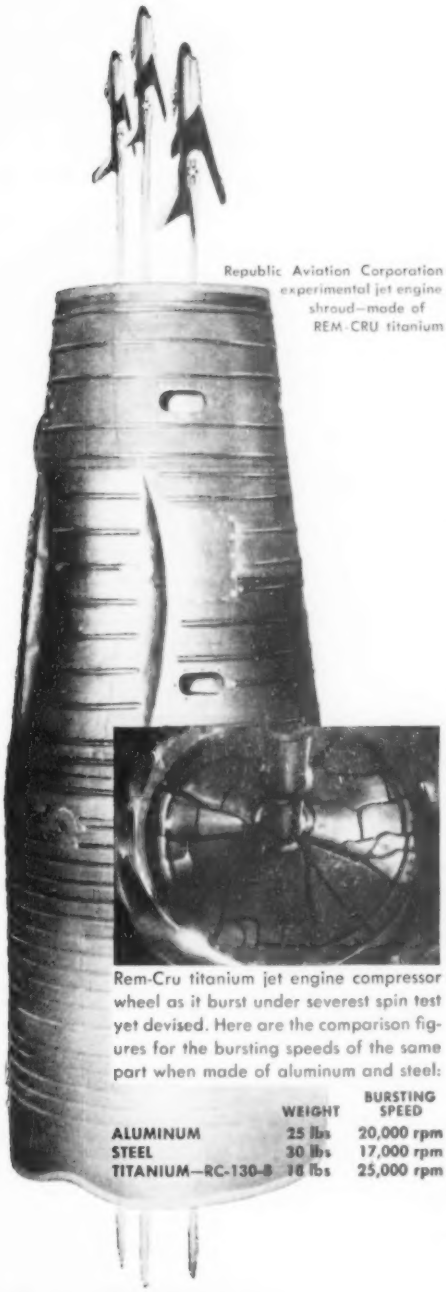

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Available for National Coarse, National Fine and Unified threads, pipe threads and spark plug threads. They are made in all standard sizes and lengths for assemblies requiring Class 3, 3B, 2 or 2B fits.

Best time to put *Heli-Coil* inserts benefits to your use is right at the designing board, as many leading manufacturers are doing. But to convince you of their many advantages ask for a working demonstration right on your production line. Write today! Complete information and engineering data is available in the *Heli-Coil* catalog. Use coupon!

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how to GAIN STRENGTH, SHED WEIGHT yet CUT COSTS with HELI-COIL* screw thread inserts

Here's how *Heli-Coil* Wire Inserts help you gain *strength*—They're flexible . . . distribute stresses over the full length of engagement. They're tough and accurate. You eliminate stripping, wear, cross-threading and corrosion in aluminum, magnesium and other metals. Equally useful in wood and plastics.

Here's how they help you shed *weight*—Because they are strong, you can use fewer or smaller fastenings. Because they end the need for solid bushings you can use smaller bosses and flanges.

HERE'S PROOF

Look at these facts—examples of the aircraft industry's growing acceptance of *Heli-Coil* Inserts:

General Electric has jumped the use of *Heli-Coil* Inserts 4 to 5 times in the J73 over the J47. In the forward frame alone the number has climbed from approximately 50 to 306.

Pratt and Whitney pioneered the use of *Heli-Coil* Inserts in spark plug openings in reciprocating engines. Today they are the largest user for this purpose.

Call in your *Heli-Coil* engineering representative for a discussion of how you can gain strength, reduce product weight, and cut costs with easy-to-use *Heli-Coil* Inserts in airframes, engines and component parts.

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ing of a price "under $15,000," observers think the 3.2-cm. set may have a final price advantage, probably small.

Bendix will be able to use waveguides, magnetrons, and other components whose development has already been financed by the military, and which are in relatively large scale production. RCA must develop a new magnetron at a cost estimated at $100,000. However, RCA says this cost will not be written off solely against airline radar sales, that it expects to find other applications for the tube.

A MATS spokesman has indicated to AVIATION WEEK that his service is extremely interested in evaluating a 5.7-cm. radar (at the Wright Air Development Center) when one is available. If the new band lives up to its advance claims, he said, the military might be interested in buying some 5.7-cm. sets.

From an upkeep standpoint, X-band supporters say that a C-band magnetron, TR, and ATR tubes, which will require occasional replacement, will be priced from two to four times higher than a set of 3.2-cm. tubes, which cost less than $300.

▶ **How to Get Reliability**—Acknowledging that it must develop a new magnetron, the other side adds that any X-band radar manufacturer had better develop a new magnetron if he expects to get the high reliability which the airlines demand. They say that military radar components are frequently designed too close to the ragged edge, to get maximum power output, minimum size and weight.

The new C-band "maggie," they say, will be designed with a very conservative power rating to assure long dependable life. Because it is larger, it will be less critical to manufacture, a further boost for reliability.

But X-band proponents point to an Arinc report issued following a visit to RCA's tube division in Harrison, N. J.

The report says: "RCA representatives indicate that to maintain reliability of magnetrons in production, it is necessary to have continuous production . . . of the order of 100 per month or greater."

Unless C-band magnetrons find wider application than in airline radar, they would have to be overproduced and stockpiled to anticipate airline needs. The production line would then have to be shut down and started up at a later date when the stockpile was depleted.

▶ **Service Shakedown**—The X-band camp says that component reliability comes from service shakedown and experience, as well as from proper circuit application. They point out that available X-band components have already had this shakedown, that new 5.7-cm. components must get theirs in airline service.

To this the other side replies that the

Jet Parts and Assemblies

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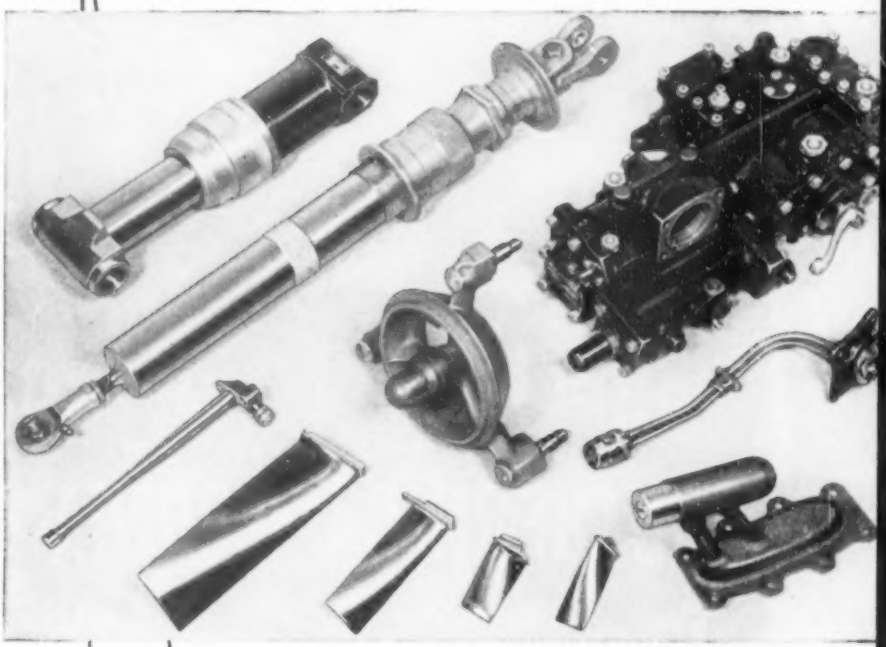

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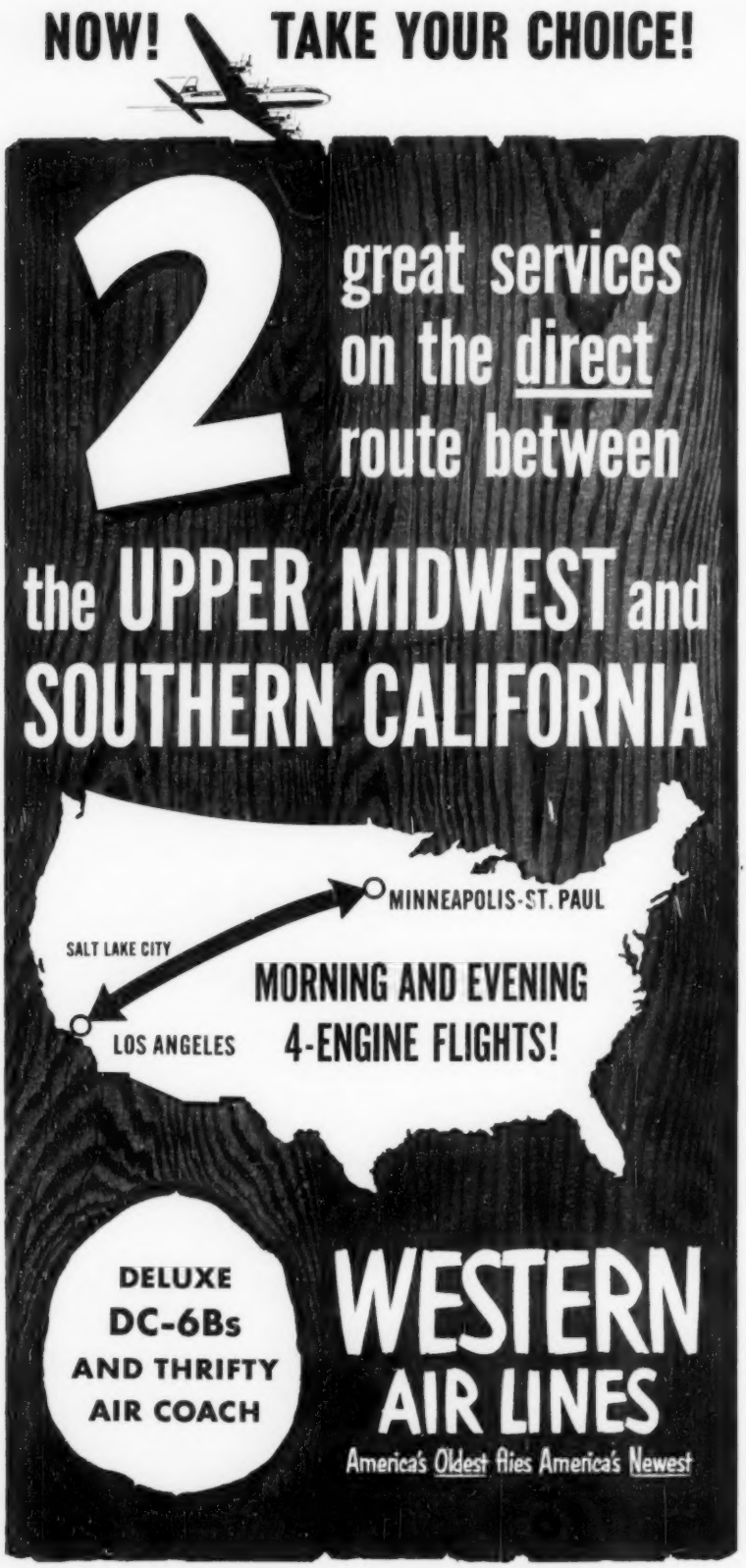
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airlines do not want a "warmed over APS-42," that the airline radar should incorporate latest design techniques. They say there will be a temptation for an X-band radar maker to apply older circuits and techniques, previously used in military sets. Bendix Radio spokesmen emphatically deny this, saying their set "will not use any APS-42 subassemblies," will be "completely new."

(Both RCA and Bendix Aviation produce APS-42s for the military. At RCA, APS-42s are produced by the same division which is designing the airline radar. At Bendix, the two programs are in separate divisions, with APS-42s produced at Bendix-Pacific.)

➤ **Summing It Up**—One airline official summed it up this way for AVIATION WEEK:

"We figure that 3.2-cm. radar will do the job X% of the time, a 5.7-cm. radar Y% of the time. We know that neither figure is 100%, that the 5.7-cm. percentage is larger, but how much larger we don't know. We don't know how much larger, heavier, or costlier the C-band radar will be. When we can fill in some of these unknowns, then we can make our decision."

Both sides agree that any airborne radar is vastly better than none. Pilots using airborne radar for the first time are universally enthusiastic over the otherwise unavailable thunderstorm information which it provides. This factor coupled with the lack of direct comparative tests on the relative performance of C- and X-band radars, explains the enthusiastic claims of both sides.

The airlines will settle the argument in the traditional American way, in which consumers generally decide such controversies. Probably both radars will find airline customers. Meanwhile, the added competition should accelerate the date when airliners are equipped with weather radar.

IRE Group to Hear Gen. Wood of ARDC

Brig. Gen. Floyd B. Wood, USAF, has been named as the speaker at the luncheon of the Institute of Radio Engineers' professional group on aeronautical and navigation electronics (PGANE) in New York, Mar. 23, during the national IRE convention. Gen. Wood, deputy chief of staff for development at the Air Research & Development Command headquarters, will discuss the effects of latest revisions in the AF's Air Weapons System Management Plan on the avionics industry.

Under the AWSM plan, the airframe manufacturer was given responsibility for procuring all avionic equipment

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Write for full information in Bulletin HA-2

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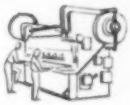
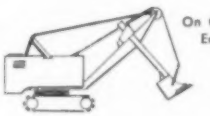
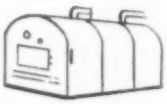
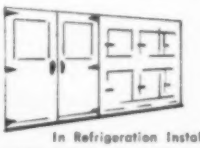



On Out-of-Door Equipment

On Driers, Furnaces, Heaters

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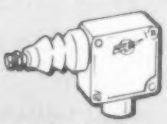
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VICKERS VISCOUNT FACTS *that count*

Within six months of its introduction, British European Airways announced the following figures for their Vickers Viscount operations:

Total revenue earned	$3,920,000.00
*Total costs incurred**	$2,814,000.00
Total profit earned	$1,106,000.00

For a total of 6,140 revenue hours this adds up to a profit of

$179.20 PER FLYING HOUR

(Conversion from Sterling to dollars, $2.80 to £)

Moreover this was achieved in the early months of the Viscount's operational service, when the utilisation was still at the low annual figure of 1,560 hours.

BREAK-EVEN LOAD FACTOR FOR FIRST SIX MONTHS TO COVER ALL COSTS:

51%

BREAK-EVEN LOAD FACTOR FOR FIRST SIX MONTHS TO COVER DIRECT OPERATING COSTS:

28.1%

* BRITISH EUROPEAN AIRWAYS TOTAL COSTS TAKE INTO ACCOUNT ALL OVERHEADS AND INTEREST ON CAPITAL

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used in his aircraft. The plan, which created many uncertainties in the avionics industry when it was first announced last year, has more recently been revised by AF Regulation 70-9. Following his formal remarks, Gen. Wood has agreed to answer questions from the floor.

Gen. Wood was chief of staff at the Wright Air Development Center prior to assuming his present duties at ARDC. He holds ratings of command pilot, combat observer and aircraft observer. He holds an MS degree from MIT.

The PGANE luncheon will highlight two days of avionics activities at the national IRE convention, including three technical sessions on Mar. 22-23. Tickets are available from local PGANE chairmen or from W. P. McNally, W. L. Maxson Corp., 460 W. 34th St., New York 1, N. Y.

New Avionic Devices

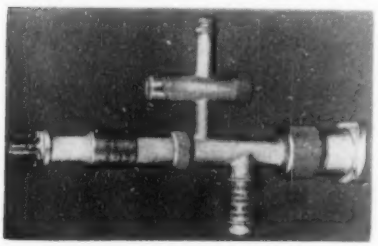
Some recently announced components suitable for use in avionic applications include the following:

• **High-temp. solenoid,** for actuating a variety of aircraft or missile devices, can be operated at temperatures of —55 to 260C, according to manufacturer, PSP Engineering Co., 8420 Otis St., South Gate, Calif.

• **Resistor networks,** with precision wire-wound resistors connected in any desired configuration, are housed in a hermetically sealed, octal-base container. New type 1169 network can be supplied with up to five 1-megohm resistors, or up to ten ½-megohm resistors, matched to within 0.02%. Unit will withstand temperature cycling between —65 and 125C, says manufacturer, Daven Co., 191 Central Ave., Newark 4, N. J.

• **Small contactor,** No. A-53-110, for 28 v. d.c. operation, has contacts rated for 25-amp. resistive load, 20-amp. inductive, 15-amp. motor load. Unit weighs 6¼ oz.; its dimensions are approximately 1½x2x2¾ in. Electrical Products Corp., 1100 N. Main St., Los Angeles 12, Calif.

• **Coaxial crystal mixers,** fixed-tuned CM-107 series, cover frequency range of 225 to 5,600 mc. Input VSWR is reportedly better than 2:1 for all frequencies and local oscillator rejection at the intermediate frequency is better



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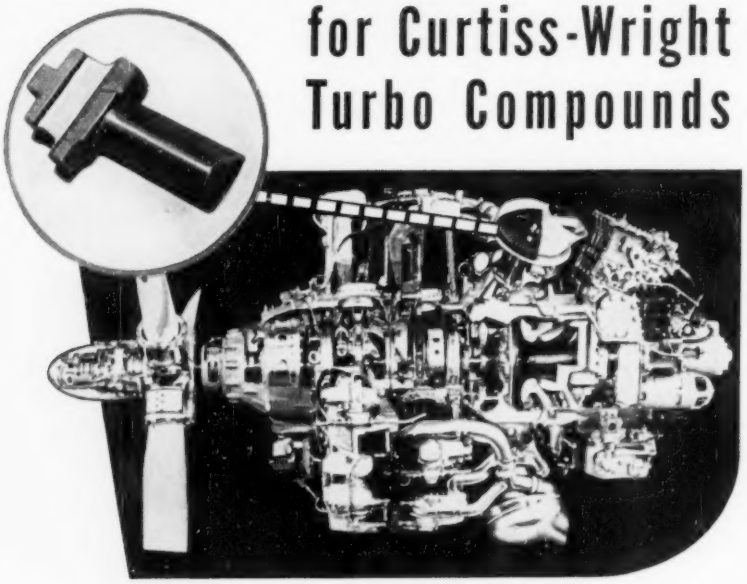

This intricate bucket is an integral part of the power recovery units in the powerful Curtiss-Wright Turbo Compound Engine (shown above) which is now rated at 3700 h.p. for the U. S. Military Services and has been selected by 22 of the World's Leading Airlines for high-speed, long range transports.

Production of this complicated component clearly constitutes a notable MISCO achievement in practical engineering, metallurgical knowhow, and highly skilled techniques to meet the most exacting requirements.

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than 30 db., manufacturer says. Local oscillator power required is 10 mw. Empire Devices Prod. Corp., 38-15 Bell Blvd., Bayside 61, N. Y.

• **Precision wire resistors,** plastic encapsulated wire-wound, called N-Caps, meet or exceed MIL-R-93A requirements, according to manufacturer, Eastern Precision Resistor Corp., Richmond Hill 18, N. Y.

• **Oil-filled capacitors,** of small tubular construction, are available in single and dual units, 2 to 8 mmf., rated 600 to 1,500 v.d.c. Units filled with Pyroteen can be operated between −70 and 90C. Industrial Condenser Corp., Dept. A-21, 3243 N. California Ave., Chicago 18, Ill.

FILTER CENTER

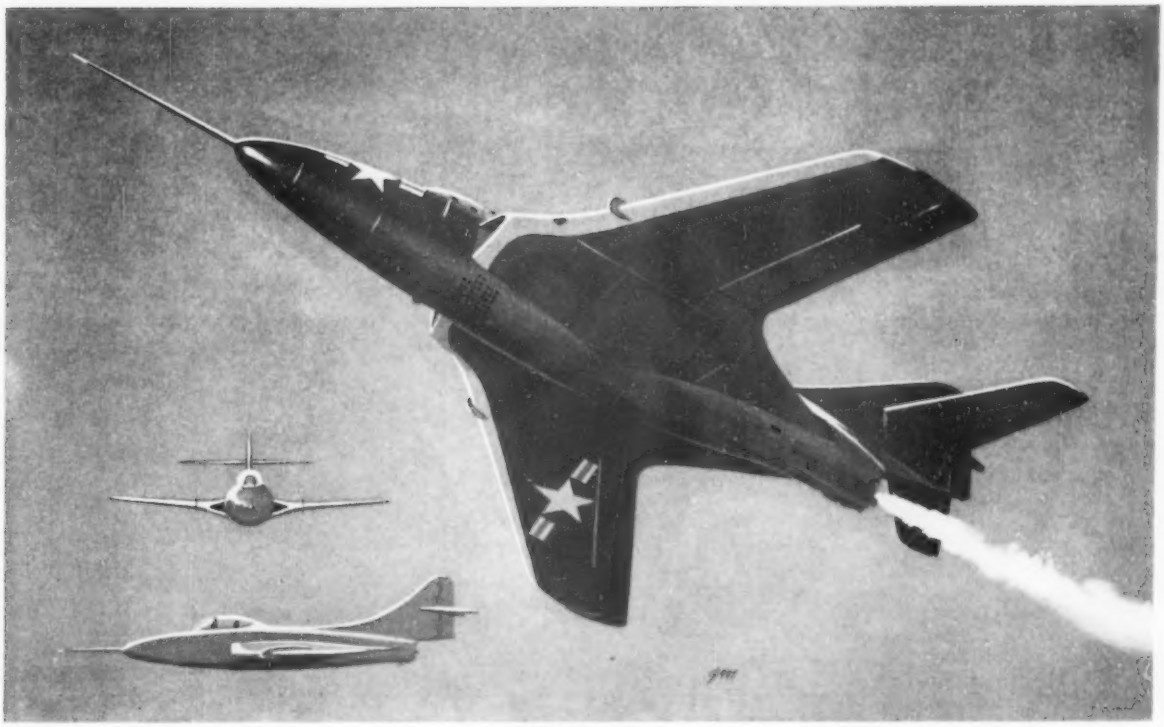
▶ **More Silicon Transistors**—Raytheon Mfg. Co. announces that it has produced experimental silicon transistors, close on the heels of Philco's similar disclosure. Raytheon reports experimental transistors have been operated at 350F and higher, but cautions that considerable work remains before production quantities will be available.

▶ **'Tinkertoy' Name Abandoned**—Navy is dropping code name of "Project Tinkertoy" for its automation program at request of original childrens-toy manufacturer who feared loss of trade-name. Instead, Navy will use "modular design of electronics," MDE for short, and "mechanized production of electronics," or MPE. Industry, which quickly picked up the catchy code name, may find it hard to drop.

▶ **Free Slipstick**—Handy pocket-size plastic sliderule, with A, B, C, D, and CI scales, as well as a Fahrenheit-Centigrade conversion scale, is available for the asking from Helipot Corp., 916 Meridian Ave., South Pasadena, Calif.

▶ **MDE-MPE Drawings Available**—Drawings of hand tools required for pilot or model shop production of Navy's MDE (Project Tinkertoy), and an engineering handbook of the hand-tool process (PB 111277) can be obtained from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C. A summary of the entire MDE-MPE project is also available as report PB 111275.

▶ **New Premium Tube**—New beam power amplifier, 5992, designed to replace the conventional 6V6 has been added to reliable tube line of Bendix Aviation's Red Bank Division. Each 5992 is run-in tested and aged under vibration for 45 hours, has arc-resistant base which permits operation up to



F9F-6 Cougar

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Powered by a Pratt & Whitney Aircraft J48-P-8, 7,250-lb. static thrust engine, the Cougar takes off and lands on the deck of a carrier. It has a speed above 650 mph, range of more than 1,000 miles and a service ceiling of approximately 50,000 feet.

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80,000 ft. altitude, Bendix says. Company's address is Eatontown, N. J.

▶**CPA Comets Go Collins**—Three Comet 2s which Canadian Pacific Airlines has on order will be equipped throughout with Collins avionics gear. Each plane will carry dual 618S UHF (144-channel) transceivers, 51R-3 VHF receivers, 17L-4 VHF transmitters, and 51V-2 glide slope receivers. Comets will also use Collins 51Z marker beacon receiver and integrated flight system (flight director).

▶**GE Crystal Ball**—Dr. W. R. G. Baker, General Electric vice president and manager of its Electronics Division, says GE anticipates "that 1954 will see a trend, late in the year, away from all-out production of standardized (military) field equipment toward development and manufacture of advanced forms of electronics apparatus." Baker also sees "a significant increase in the technical nature and scope of our advanced (military) equipment activities."

▶**Integrating Gyro Declassified**—The military has recently taken security wraps off the "integrating gyro," developed by Massachusetts Institute of Technology. The device is a rate-type gyro with viscous (instead of spring) restraint which functions as a displacement and rate gyro. Minneapolis-Honeywell and Reeves Instrument Co. are both producing the avionics device for the military.

▶**Avionics Literature**—Recently announced publications of interest to the avionics field include:

• **Microwave instrumentation**, covering frequencies from 10 to 31,000 mc., including signal generators, spectrum analyzers, microwave receivers and wide-band video amplifiers, are described in new booklet available from Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.

• **Magnetic fluid clutch positioner**, for use in driving recording pens or other instrument-type elements, with linear response out to 5 cps., is described in Bulletin No. DL-C 311, available from Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Tex.

• **Micro switches**, in a variety of types with many different actuating elements, are described and application data given in data sheets 64a, 66, 68a, 71, P74, and P75, available from Micro Division, Minneapolis-Honeywell, Freeport, Ill.

• **VSWR Measurement**, techniques for obtaining precision measurements of microwave impedance using slotted sections, are described in the October 1953 issue of Polytechnic Research & Development Co. reports. Company's address: 55 Johnson St., Brooklyn 1, N. Y.

• **Radio Compass Panel**, a new miniaturized version for remote control of an ARN-6 receiver, is described in bulletin prepared by Electronics Division, North American Philips Co., 750 S. Fulton Ave., Mt. Vernon, N. Y. —PK

25 YEARS OF SIMULATED FLIGHT

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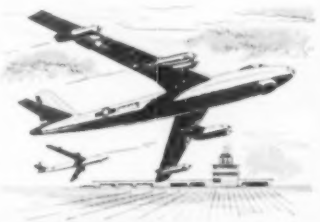

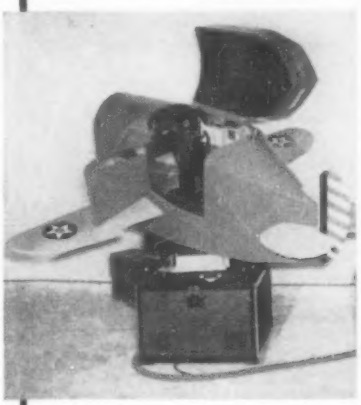

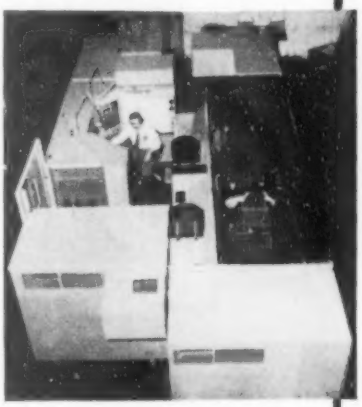

Pilot training gained a new ally when the first Link Trainers made their bow a quarter of a century ago. Instrument Flying Trainers such as the C-3 Link above, gave basic and refresher instruction to more than half a million pilots in World War II.

Like their predecessors, modern Links help to provide this nation with the world's most proficient pilots. New electronic giants such as the Link B-47B Flight Simulator are aiding Air Force pilots to master the instrument techniques of modern jet aircraft.

AND YET TO COME...

The research and development staff of Link is currently at work on new projects that will fill the needs of future high speed flying... and flying men... importantly as in the past and present.

25 YEARS OF SIMULATED FLIGHT

LINK
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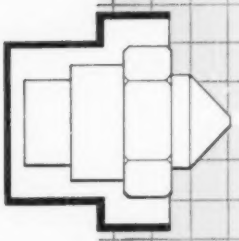
5

IF FLAMES COULD BE 'FROZEN'



If a flame pattern could be "frozen" at simple ambient conditions, and then methodically reproduced to perform under all flight conditions—life in the combustion engineering business would be a lot simpler. The fact is, of course, that theory gives out long before the perfect picture has been drawn.

And so . . . to achieve higher-than-ever combustion efficiency . . . to locate electrodes in just the right place for positive ignition . . . to develop new tricks (like sweat cooling) for elimination of hot spots . . . to produce controlled turbulence . . . to cut down resonance . . . in short, to get flame to conform to plan is a basic objective we reach through use of the large fund of flame facts we've built over the years. If you face any of these combustion problems, your Janitrol representative can quickly show how our facilities may fit into your program.

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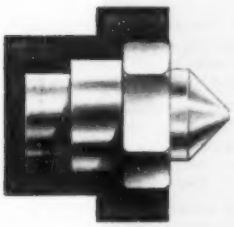
Copies of either, or both, are available on request, on your letterhead, please.



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Inasmuch as the 21st Annual Inventory issue will be a record one in terms of Industry usefulness, Military and Government reference, all companies Manufacturing for or serving the Aviation Industry are urged to be represented in this edition.

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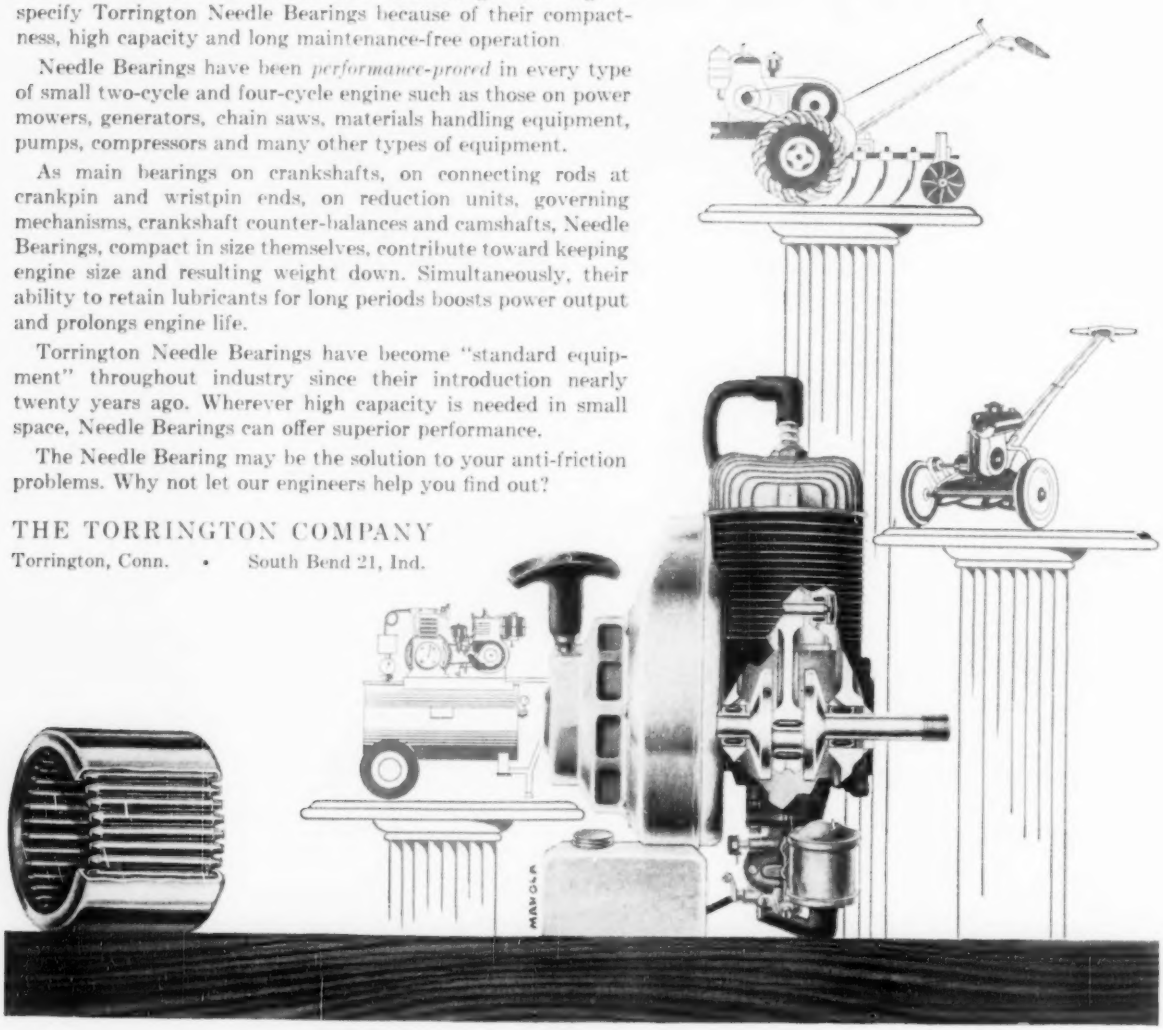

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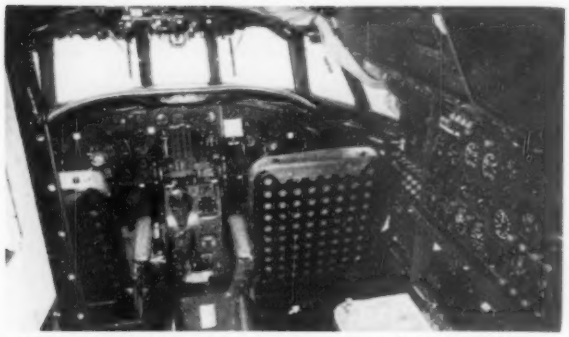
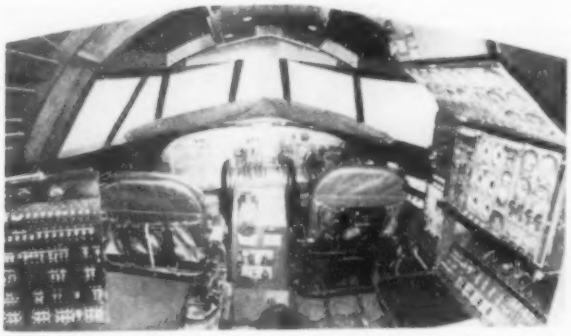


ACTUAL COCKPIT of Constellation airliner differs little from . . .



MOCKUP developed by LAS as a portable procedure trainer.

LAS Builds Constellation Training Aids

• Flight deck's simplicity allows easy conversion to nearly any type transport; advantage is its low cost.

Newest of a long line of training aids created by Lockheed Aircraft Service is a portable procedure trainer. Although designed to duplicate the flight deck of a Constellation, LAS says the unit's components are easily interchangeable, making it feasible to convert the device for use as a trainer on almost any type of transport aircraft.

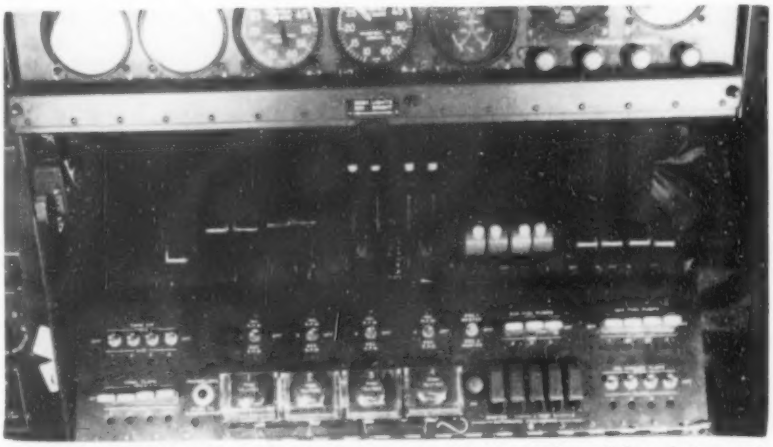
The trainer, developed by LAS in conjunction with Lockheed Aircraft Corp., serves to teach flight crews correct preflight, inflight and after-flight techniques and how to handle any emergency quickly and correctly. An instructor, sitting in the place normally occupied by the Connie's radio operator, checks the student's reaction, time and accuracy.

▶ **Simple and Cheap**—Principal advantages cited by Lockheed for its new trainer are simplicity, low cost, low maintenance and mobility.

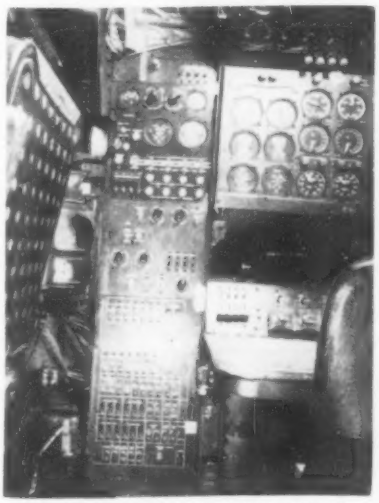
• **Simplicity.** Only the instruments absolutely necessary to the proper operation of the trainer are used. Photographic reproductions are used for instruments of secondary importance, providing considerable economy plus reduction in maintenance and weight. No electronic tubes are used in the electric circuits. Power source is 115-v., 60-c. alternating current.

• **Low cost.** Built of plywood, the trainer is inexpensive compared to other devices designed to serve the same purpose, LAS says.

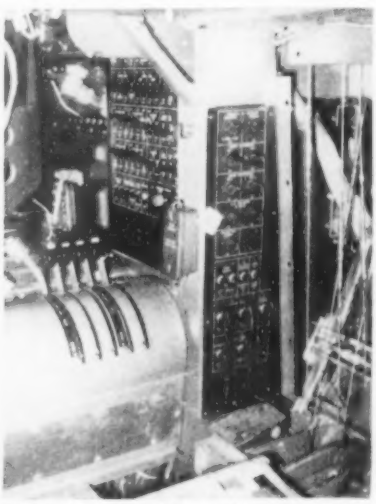
• **Low maintenance.** By restricting elec-



FLIGHT ENGINEER'S station duplicates powerplant controls, switches, instruments.



JUNCTION box has all switches, breakers.



FUEL controls are changeable to all models.

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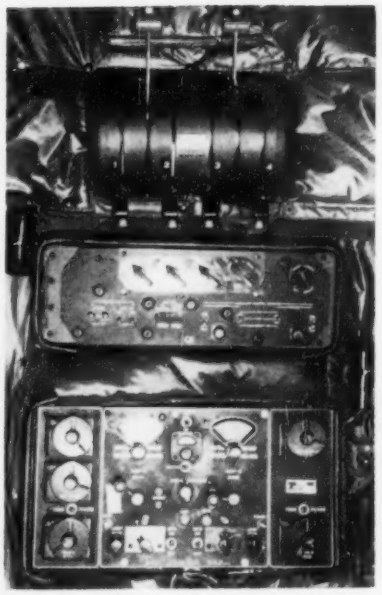


RADIO PANELS are photo reproductions.

STATION 260 air conditioning controls.

trical components to simple servomechanisms, motors and switches, and using ruggedly constructed components in parts subjected to continuous use by student or instructor, maintenance of the trainer is kept as low as possible, consistent with the job the device is designed to do.

• **Mobility.** The trainer was designed with an eye to quick and easy assembly and disassembly. Components are packed in kits which are readily air-transportable. Thus the number of trainers that is needed may be kept to a minimum.

▶ **What It Does**—Here are the jobs the trainer was designed to do:

• It allows the instructor to teach, and observe the students perform, such items as engine starting, warm-up and taxiing.

• Instructor can check climb, traffic pattern, after-landing and parking procedures.

• Trainer allows instructor to present student with such emergencies as engine failure, propeller malfunctioning, fire, failure of the aircraft's systems, overheat conditions, emergency gear extension, braking emergencies, and fuel dumping.

A feature of the device is a method which allows the instructor to "slow-motion" or retard the rates of response of various mechanisms, or even stop them completely. This allows student to study unhurriedly what is going on and discuss the problem with his instructor, much as athletes may study slow-motion movies of their sport to improve their proficiency.

The trainer may be operated 24 hours a day as an around-the-clock classroom, allowing a single device to handle large volumes of students.

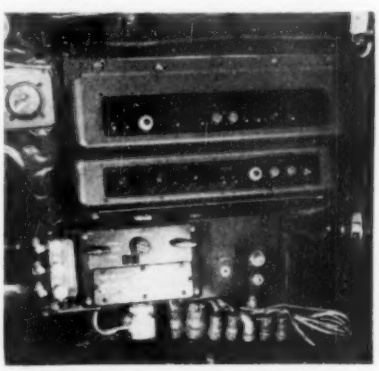
▶ **From a Long Line**—Lockheed Aircraft Service has had a good deal of experience in building training devices, including the first trainer for Lockheed Constellation flight engineers.

Starting in 1942, it produced aids and training panels for instructing pilots and crews of such aircraft as the P-38 fighter and the Navy PV-1 and -2.

These were followed with special, mobile training units and mock-ups for the F-80 Shooting Star. LAS says that "so successful were the results with these devices that mobile training unit construction became an integral part of Lockheed Aircraft Service activities."

Good results obtained with the F-80 training devices prompted the USAF to place orders with LAS for similar devices for the F-94A, -B and -C. These disassembled-type units, pointing up the military's need for air-transportable training devices, were shipped to USAF units all over the world.

For the Navy's BuAer, LAS developed training devices for several models of the P2V patrol bomber, including the



CO-PILOT'S side panel has all switches.

-4, -5, and -6 series of the Neptune.

LAS estimates that it has designed and created approximately 250 training systems—150 for the Navy and 100 for the USAF. In addition, LAS estimates that over 2,000 aircraft maintenance supervisors, mechanics and flight engineers have been trained in the operation and maintenance of Constellations with its training devices. Both civilian and military are included in this total.

► **Improvements**—Here are some of the improvements LAS has incorporated in its newer training panels to improve their simplicity and economy:

Animated devices have been substituted, where possible, for actual instruments. Lights replace pumps and similar components to indicate their correct functioning. Painted lines represent flow of liquids. All these changes result in economy and weight saving without sacrificing the panels' utility, says LAS.

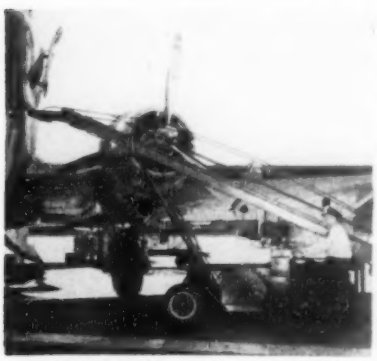
CAL Develops New Hydraulic Loader

A self-propelled, hydraulically operated cargo conveyor has been developed by Continental Air Lines, Inc., for use at its Denver terminal, and is being marketed by the carrier. The device is manufactured by Mechanics Service Co., Cripple Creek, Colo.

Called the Hydro-Veyor, the three-wheel vehicle has a conveyor belt platform that raises to a maximum height of 14 ft., which Continental officials say is high enough to handle loading and unloading on any presently operated airline airplanes.

The Hydro-Veyor is powered by an 8.5-hp. aircooled Briggs & Stratton gasoline engine, with electric starting for all weather conditions. The engine drives a hydraulic pump which powers all of the conveyor operations. This includes propelling the Hydro-Veyor forward or reverse, raising the conveyor belt and propelling the belt forward or reverse.

Frank Dakan, Continental facilities engineer who designed the device, says



HYDRO-VEYOR moves into position for nose loading of DC-3.

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An Aerotec P-904 Pressure Switch installed in the de-icing system of a Boeing Stratocruiser performed without any functional failure during thousands of flight hours. Upon removal, no drift in the pressure setting had occurred, and the unit was still in excellent condition.

Frequently used in the de-icing or cabin-heater systems of larger aircraft, the Aerotec P-904 Type Pressure Switches are also utilized to control ground heating blowers as well as flap, landing-gear and stall-warning devices.

Among the aircraft using Aerotec P-904 Type Pressure Switches are: Boeing B47 Stratojet and B50D Superfortress, Grumman XS2F, Douglas C124C, North American AJ-1 and Chase C123B. More than 15,000 units are in service today.

The exhaustive and conclusive tests of Spec MIL-E-5272 which the P-904 has successfully passed guarantee that Aerotec Automatic Controls will satisfy even the most rigorous specifications.

Aerotec Pressure Switches of various types are available for pressures ranging from 1.5″ H_2O to 3,000 psi.

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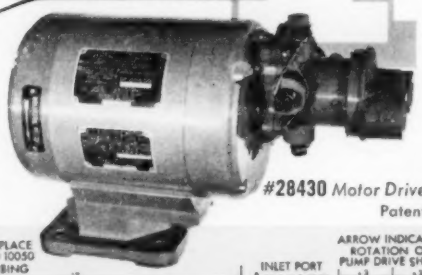

#28430 *Motor Driven Hydraulic Pump*
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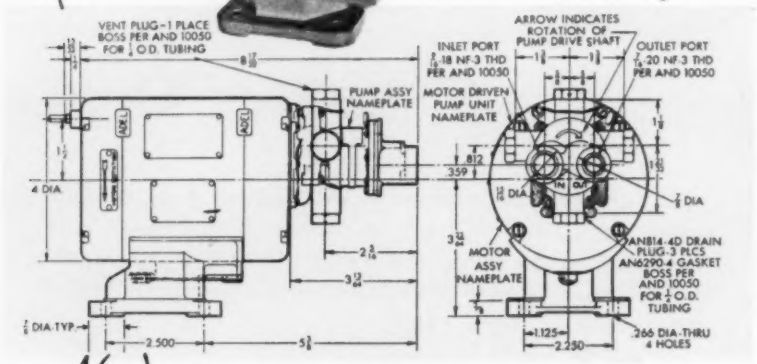
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⅜ DIA
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the hydraulic system applies 60 hp. on the drive wheel. The gasoline engine drives the hydraulic motor, which is rated at 8 hp., 1,000 psi. and 8-gpm. flow.

All of the drive power is applied to the third, or castering wheel. Power steering enables the operator to maneuver the Hydro-Veyor with extreme ease, Dakan says. The turning radius of the inside front wheel is 20 inches.

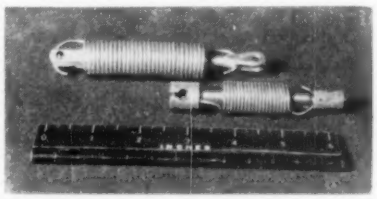
Simplicity of the controls is rated by Dakan as one of the conveyor's unique features. Forward and reverse movements are controlled by a hand valve which is spring-loaded to apply the brakes when released. There are no clutch or brake pedals. The operator rides a tractor-type seat at the side of the conveyor when maneuvering it into position beside an airplane. Other simple hand controls raise the belt and start it operating in forward or reverse direction.

Dakan designed the device with the help of E. L. Fry of Cripple Creek, Colo., and C. L. Fry, Denver, who operate Mechanics Service Co. Dakan was also assisted in his design work by Richard Schorling, director of purchasing and property of CAL.

Dakan says the conveyor takes only one-third the time of manual workers in loading or unloading an airliner. He says that formerly it required three men about 15 min. to load or unload the average 1,200 lb. of cargo and baggage at Denver. With the Hydro-Veyor, two men stationed at each end of the belt can do the job in five minutes.

One of the biggest advantages, Dakan says, is that the device will handle with ease heavy pieces of cargo that normally would require four or five men to lift.

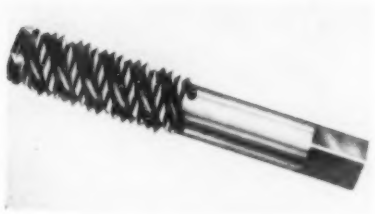
Continental is ready to market two models. One is a de luxe type with power steering, spotlights on the conveyor belt, head-, taillights and horn, wheel pants and splash panel cowling. Its price (f.o.b. Denver) is $2,895. A basic model with manual steering and without lights is available for $2,495.



Eliminates Cable Slack

These control-cable slack compensators, used on aileron and elevator control systems of the Northrop F-89 Scorpion twin-jet interceptor, have been licensed by their developer, Northrop Aircraft, Inc., to E. H. Stau Co., Los Angeles, which will make and market the device.

NEW AVIATION PRODUCTS



Tap Produces High-Torque Self-Lock Internal Thread

A new tap that produces a self-locking internal thread offers the aviation industry the possibility of considerable savings.

By eliminating the need for locking devices, such as locknuts, castellated nuts, lockwashers, cotter pins, etc., this development can save as much as $2,000 in the cost of producing a four-engine transport plane, and up to $4,000 on a multi-jet bomber, says Shearcut Tool Co., maker of the tap. Other savings seen by the company: $275 on a jet fighter, $7.50 on a jet engine, $15 on a piston engine.

Known as the Shearcutter Ever-Lock Tap, the tool is now made in PG-11 tap classes only. Tolerances are held extremely close, the company says, to produce three classes of fits: snug, tight and extra-tight. Standard go-no-go thread plug gages, Class III fit, may be used for inspection.

Locking torque is twice the government requirement on first removal, and more than 25 times that required on twentieth removal, Shearcut says.

Shearcut Tool Co., Ever-Lock Tap Div., 7045 Darby Ave., Reseda, Calif.

Highspeed Hand Tool Grinds Steel or Wood

A new heavy-duty, highspeed Dumore hand tool grinds, mills, finishes and polishes materials ranging from wood to hard alloy steel, the maker reports.

Powered by a ¼-hp. universal motor that delivers speeds up to 35,000 rpm., the Series 35 can be used with tungsten carbide mills, highspeed cutters, mounted wheels and points and abrasive bands.

Overall length of the 3-lb. handgrinder is 10¾ in.; body diameter measures 2 7/16 in., and small diameter is 1⅞ in.

The tool is available for 115-v. or 230-v. d.c. or a.c., 0-60-cycle operation with ⅛-in. or ¼-in. collet chuck.

Dumore Co., 1300 Seventeenth St., Racine, Wis.

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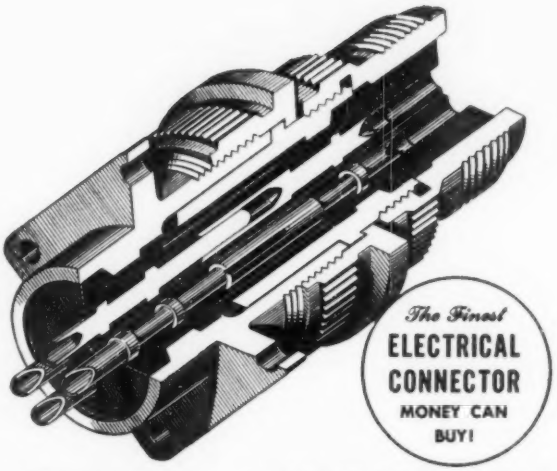

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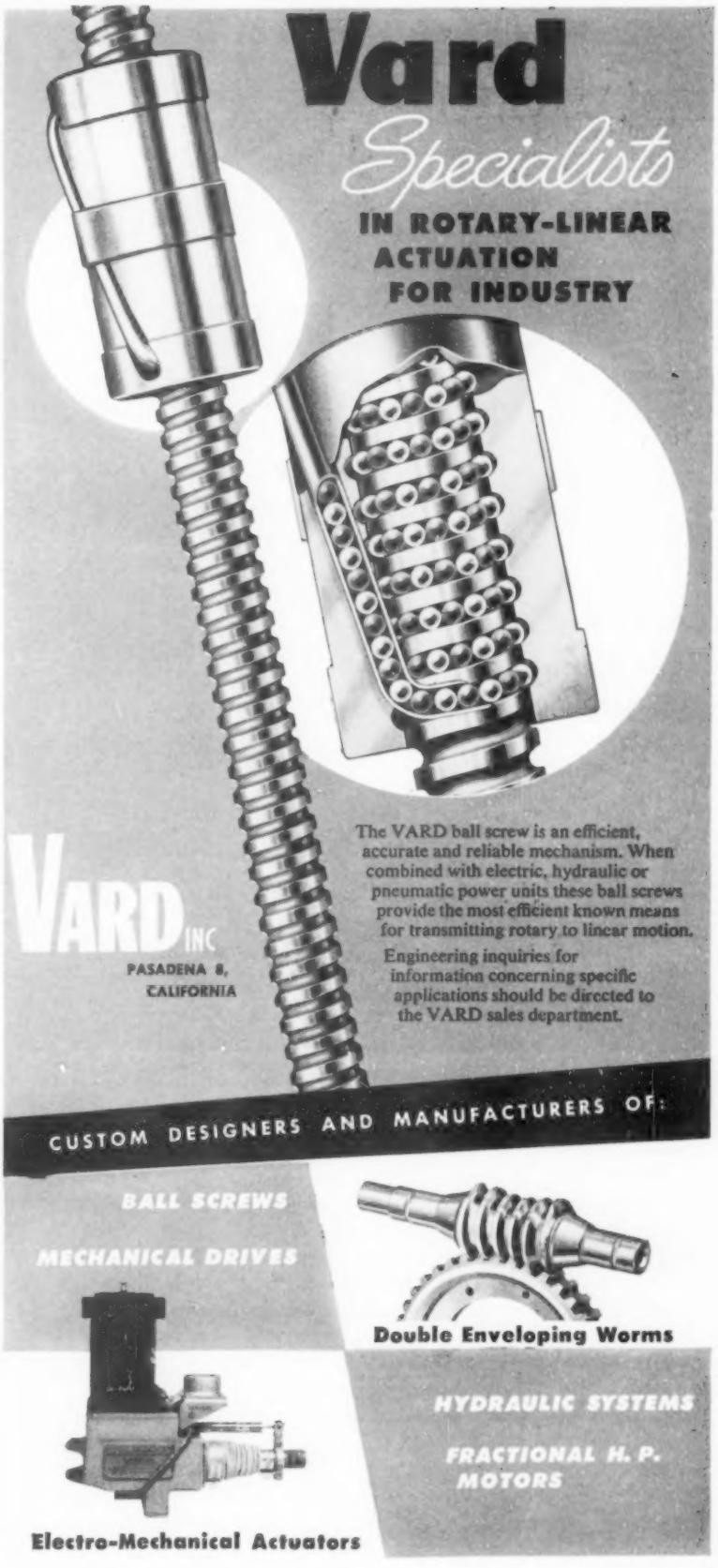
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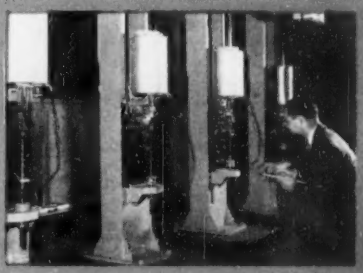

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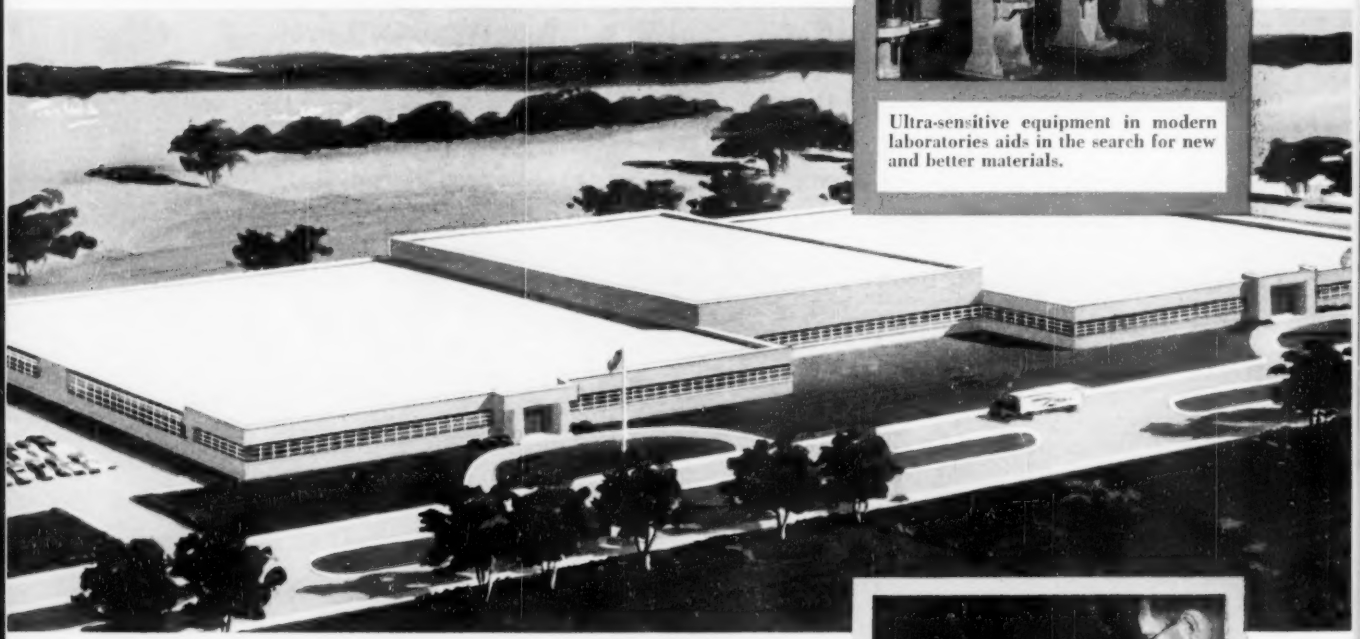

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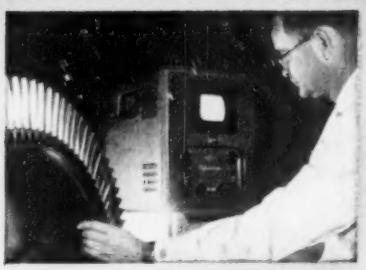

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AVIATION SAFETY

CAB Accident Investigation Report on WAL DC-6B:

Pilot Misjudged Altitude Over Bay

THE ACCIDENT

Western Air Lines' Flight 636, a Douglas DC-6B, N 91303, crashed in San Francisco Bay approximately midway between San Francisco International Airport and Oakland Municipal Airport at about 2308 PST,[1] Apr. 20, 1953. Two of the 10 occupants, a stewardess and a male passenger, survived. The aircraft was demolished and sank.

HISTORY OF THE FLIGHT

Flight 636 originated in Los Angeles for Oakland, Calif., with an intermediate scheduled stop at San Francisco, Calif. Capt. Robert E. Clark, First Officer Robert C. Jacobson, Flight Engineer Robert R. League and Stewardesses Barbara Brew and Beverlee Nelson comprised the crew. There were 35 passengers upon departure from Los Angeles and 2,165 gal. of fuel. The gross weight was 83,952 lb., 3,925 lb. less than the allowable maximum, and the load was properly distributed with respect to the center of gravity of the aircraft.

Weather conditions over the route, Los Angeles-San Francisco-Oakland, were well above prescribed minima and forecast to remain so for the duration of the flight. A flight plan was filed with Air Route Traffic Control at Los Angeles, and the flight was cleared on an Instrument Flight Rules flight plan from Los Angeles to San Francisco via Airways Amber 8, Victor 27, Victor 25 and Blue 54, to cruise at 13,000 feet mean sea level. Elapsed time to San Francisco was estimated as one hour and 30 minutes. Visual Flight Rules were specified for the San Francisco-Oakland segment. Oakland and Sacramento were chosen as alternate airports for San Francisco.

Departure from Los Angeles was at 2100. The flight proceeded in a routine manner at its assigned altitude arriving at San Francisco at 2240.

Thirty passengers deplaned, five remained aboard for Oakland and no other passengers boarded. During the stop at San Francisco, a walk-around inspection of the aircraft was performed by the flight engineer and a Western Air Lines mechanic; it revealed no discrepancies. Fuel aboard was 1,700 gal.; none was added, nor was maintenance accomplished at San Francisco.

The weather observations for the San Francisco Bay area at about the time of takeoff from San Francisco were:

- San Francisco—
  - 2300: Measured ceiling 800 feet, broken clouds. Visibility 10 miles, wind west-southwest 7, altimeter setting 29.89.
  - 2315, 10 minutes after takeoff: Measured ceiling 900 feet, broken clouds. Visibility 10 miles, wind west-southwest 10, altimeter setting 29.88.
- Oakland—
  - 2300: Measured ceiling 700 feet, overcast. Visibility 10 miles, wind west-southwest 4, altimeter setting 29.89.
  - 2312, seven minutes after takeoff: Measured ceiling 800 feet, overcast. Visibility 10 miles, wind west-southwest 4, altimeter setting 29.89.

Flight 636 was cleared direct to the Oakland tower, to remain clear of clouds at a minimum altitude of 500 feet. Takeoff was on Runway 28R at 2305.

Two minutes later, at 2307, the flight called Oakland, advised that it was on a trans-bay clearance to the Oakland tower and requested further clearance to the airport. Oakland tower cleared Flight 636 to enter the traffic pattern for landing on Runway 27R, and gave the wind west at 10 miles per hour. Acknowledgment was the last contact with Flight 636.

INVESTIGATION

Testimony of witnesses firmly established the fact that Flight 636 was normal and routine in all respects between Los Angeles and San Francisco. A walk-around inspection of the aircraft at San Francisco and the absence of any complaints of mechanical or other difficulties by the captain, indicates that N 91303 was airworthy upon departure from that station. It is therefore unnecessary to dwell further on this phase of the flight.

On departure from San Francisco, the gross weight, fuel aboard and the weather conditions were well within the limits prescribed by the Civil Air Regulations and Western Air Lines.

The clearance under which this flight departed San Francisco is known as "Visual Trans-Bay" and is used for traffic between San Francisco and Oakland. It is issued when the ceiling and visibility at both airports is less than 1,000 feet and/or three miles visibility and a minimum combination of ceiling and visibility (sliding scale) is required for its issuance. This procedure was established through the medium of a Joint Operations Letter Revised effective Apr. 10, 1952, for the purpose of expediting traffic between San Francisco and Oakland. The applicable parts of this letter are set forth below.[2] The ceiling and visibility at San Francisco was 800 feet and 10 miles; 700 feet and 10 miles at Oakland.

Flight 636 took off on Runway 28R at 2305, turned to its right in the direction of Oakland Airport and two minutes later reported to Oakland tower at 2307: "Oakland tower this is Western 636, off San Francisco,

[1] All times herein are Pacific Standard and are based on the 24-hour clock.

[2] Footnote appears at bottom of p. 91.

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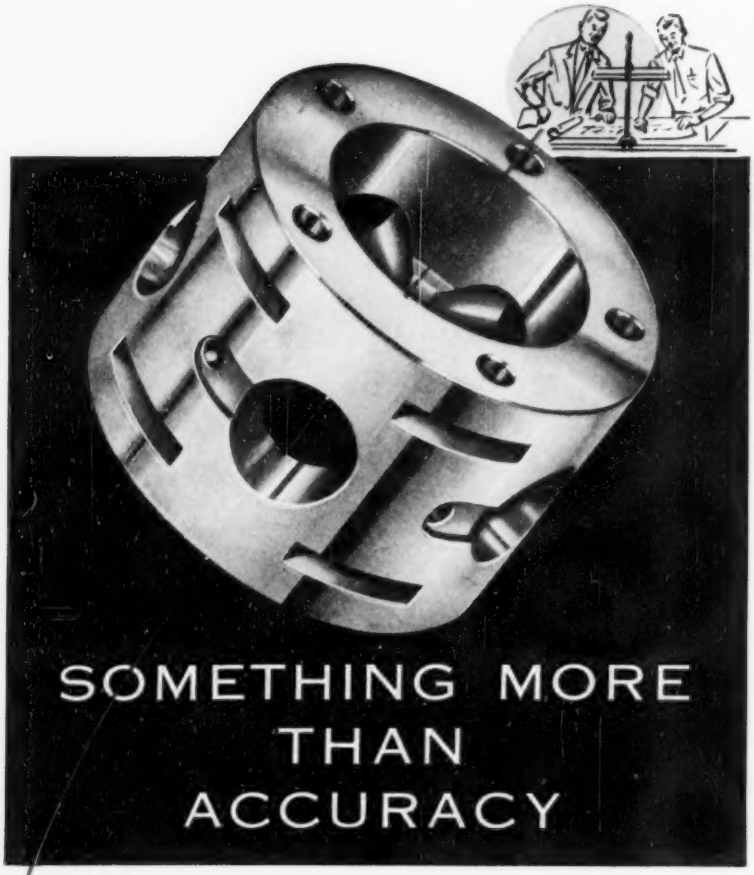

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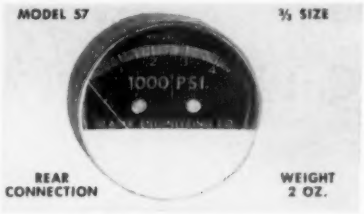

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Trans-Bay, landing instructions, over." The Oakland tower replied by issuing the following clearance: "Western 636, Trans-Bay, cleared to enter traffic pattern, Runway 27 Right, wind west one zero." The flight acknowledged these instructions.

It is to be noted that at 2301, four minutes before 636 took off from San Francisco, the San Francisco tower called Oakland tower on the interphone and requested a trans-bay clearance for this flight. The Oakland tower replied by issuing the following clearance: "Western 636 is cleared to the Oakland tower via the direct route, remain 'clear of clouds'." The distance between the two airports is approximately 11.5 statute miles. Tower operators in both places stated that they could see the lights of the opposite airport clearly and distinctly at the time.

The Oakland surveillance radar detected Flight 636 just as it was completing the right turn toward that airport and continued to observe it until it was within range of the six-mile scale at which time it was followed on the shorter range scope. At about 2308 tower operators in both Oakland and San Francisco saw a large orange colored flash in the direction of the aircraft's track. The target disappeared from the radar scope at this moment and the radar operator marked its last position as 5.5 miles, on a bearing of 217 deg., from the Oakland radar. Attempts to contact Flight 636 by both San Francisco and Oakland towers were unsuccessful.

The Oakland tower immediately alerted the San Francisco Coast Guard station and the Alameda Naval Air Station. The Coast Guard quickly dispatched two helicopters and three airplanes to the area, the helicopters being guided by Oakland radar. They illuminated the scene with landing lights and directed the aircraft to a position over the overcast directly above the floating debris from which flares were dropped. The fixed-wing aircraft came below the overcast and reported its base as 500 to 600 feet above the water, with visibility restricted to approximately two miles. A helicopter pilot reported that visibility below 300 feet was 12 miles or better and that he could clearly see the lights on both sides of the bay. One stewardess and a male passenger were rescued by a Coast Guard boat and six bodies were recovered by Coast Guard and naval vessels. Bodies of the captain and the flight engineer were not found.

The crash occurred in water averaging 30 feet in depth at mean low tide. A variety of relatively small parts of the aircraft were recovered, the largest of which was the wing center section with the two main landing gears attached. Inspection revealed that the landing gear was fully retracted at impact. One propeller hub with the blades bent and

[2] Dept. of Comm. — CAA — LAX — Region Six — "Joint Operations Letter — Revised effective Apr. 10, 1952. Oakland Air Route Traffic Control Center No. 18. Oakland Airport Traffic Control Tower No. 7. San Francisco Airport Traffic Control Tower No. 4. Subject: Control of Trans-Bay Traffic—San Francisco and Oakland.

"1. General
The following procedures are established for the purpose of expediting the flow of trans-bay traffic between the Oakland and San Francisco Airports under certain IFR weather conditions. Control procedures will be applied in conformance with the ANC Manual of Operations, Procedures for the Control of Air Traffic, except for the deviations contained in these instructions.

"2. Control Authority
Authority for the control of trans-bay flights is delegated to the San Francisco and Oakland Towers under the following conditions:

A. Visual Flights

(1) Whenever the ceiling or visibility is less than 1,000 feet and/or three miles, a clearance will be required for all trans-bay visual flights. Flight altitudes during these weather conditions shall be not more than 1,000 feet and not less than 500 feet.

(2) Trans-bay visual flights shall not be conducted under weather conditions less than the following sliding scale minimums:

Ceiling 1,000 feet minimum visibility 1 mile
Ceiling 900 feet minimum visibility 2 miles
Ceiling 800 feet minimum visibility 3 miles
Ceiling 700 feet minimum visibility 4 miles
Ceiling 600 feet minimum visibility 5 miles

"4. Missed Approach Procedures—Trans-Bay Visual Flights

A. In the event a trans-bay visual flight is unable to maintain visual contact with the land or water, such flights will immediately advise approach control at the destination airport and execute the following procedure: . . . .

(2) San Francisco to Oakland Flights: Proceed on a heading to intercept the northwest course of the Oakland range, climbing to missed approach altitude of 2,000 feet and hold northwest of the Oakland range station in a one-minute elliptical holding pattern, all turns west of course."

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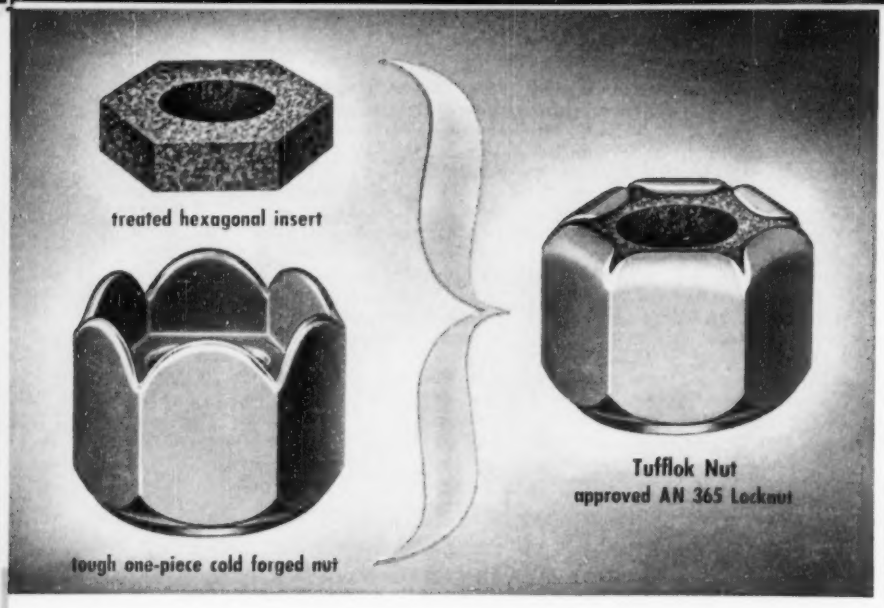

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broken was recovered but was damaged to such an extent that blade pitch settings and rpm. at the time of impact was indeterminable. The four engines were not recovered because of deep, soft mud on the bottom.

Stewardess Nelson stated that she was seated in the aircraft's lounge at time of takeoff from San Francisco, and that the takeoff appeared to be normal in all respects. She did not notice whether the "No Smoking" sign was on or not. When about five minutes out she sensed what she thought was the beginning of a gradual descent. She said she thought the aircraft had some degree of flap owing to the sound of the slipstream, and at this time she heard a decrease in power such as she was accustomed to hearing in the course of a normal landing. She then heard and felt what she presumed to be the nose-wheel striking the runway though she thought it was too soon to be landing at Oakland. Miss Nelson said she was in the water for about one hour before her rescue.

The passenger, Vilas F. Adams, stated that the takeoff from San Francisco was normal and that he could see the lights on both sides of the bay. When over the water, he said, the aircraft banked to the right and headed for Oakland. After about two minutes, Mr. Adams stated that he was still looking at the lights ashore and judged the aircraft to be about 500 feet high. Then, the next thing he noticed was that "we were about 20 feet off the water—and it appeared that we were below the lights, like we were under them." He then said that in "maybe 15 seconds" the aircraft was down about 10 feet. Following this, he said he unfastened his seat belt and stood up, whereupon the crash occurred, accompanied by a blinding flash. Mr. Adams also stated that the flight was well below the clouds at all times and that the surface of the water appeared smooth. No turns nor abnormal maneuvers were made, after the right turn to get on course, according to this witness. The wings were level, he said, with the nose slightly down. There was no backfiring nor coughing of the engines and they were all running smoothly at the time of impact, he added. Mr. Adams estimated that he was in the water about 50 minutes before his rescue.

Complete disintegration of the cabin allowed Miss Nelson to step out of the rear section of the cabin and into the water, and Mr. Adams was thrown out as the cabin broke open on impact.

The rescuing helicopters reported that at 2330 there were scattered to broken clouds in the area of the crash scene at about 400-500 feet, and that it was necessary to descend from their cruising altitude of 600 feet in order to stay clear of clouds, at which altitude the visibility was about two miles. In the immediate vicinity of the crash scene, at altitudes of 300 feet and below, visibility improved and lights on both sides of the bay were plainly visible. The air was smooth below the overcast.

Crews of other flights operating trans-bay within the hour before and after the accident reported ceilings varying from 400 to 1,000 feet and visibilities 12 to 15 miles.

The pilot in command, Capt. Clark, had a total of about 79 hours in Douglas DC-6B-type aircraft and approximately two and three-quarter hours of instrument time thereon. He had recently been transferred to the Los Angeles-San Francisco route and

had made 12 trips between San Francisco and Oakland. Whether these flights between these two places were made under VFR, IFR or Visual Trans-Bay could not be determined. He had been flying Douglas DC-4 and Convair 240 aircraft on his prior assignments.

ANALYSIS

From the testimony of the two survivors, it is apparent that the accident resulted from the pilot's failure to maintain sufficient altitude to avoid contact of the aircraft with the water. The precise reason or reasons for the pilot's action or lack of action in allowing the aircraft to descend into the water is a matter of conjecture. However, there were several pertinent conditions and circumstances that can be considered as contributory factors. These were the type of operation being conducted, the weather conditions that existed over the bay and the sensory illusions that can occur under certain conditions.

The type of operation being conducted was somewhat of a special nature wherein flights between the Oakland and San Francisco Airports are permitted to fly at altitudes below the minimums normally prescribed for scheduled airline operations and also below the normal Visual Flight Rule weather minimums. This has been authorized to expedite traffic between these two airports in view of the short distance involved and the fact that such flights are made entirely within controlled airspace.

Special procedures have been established in the form of sliding scale minimums for various combinations of visibility and ceiling values. Also, aircraft must remain clear of clouds and fly not less than 500 feet above the surface. If unable to remain clear of clouds at 500 feet or if unable to maintain visual contact with the surface, such flights are required to climb to 2,000 feet, intercept the northwest course of the Oakland range and hold for clearance to make a standard instrument approach. It is evident that, at the time of the subject flight, the cloud base was lower than 500 feet over portions of the bay area. Reports indicate that the ceiling in the area of the accident was approximately 400 feet. It was also found that the visibility was at least 12 miles at an altitude of 300 feet.

It therefore appears that in proceeding over the bay, the subject flight encountered a cloud condition lower than indicated from preflight reports and that the pilot, endeavoring to stay clear of clouds as required for this operation, descended below the minimum altitude of 500 feet. In doing so, the pilot may have lost visual reference to the surface both with respect to the lights on shore and to the surface of the water. As the waters of the bay were reported as smooth, a condition existed that made it extremely difficult if not impossible to judge distance above the water especially as it was at night and when no other means of reference were available for visual orientations.

In this connection, the third condition enters the then existing situation. This is a condition wherein an erroneous belief of an aircraft's altitude can occur when attempting to maintain orientation by means of visual reference to distant lights. In this case the aircraft was approaching the shore some five

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miles distant where there were numerous lights. But the concentration of the much stronger lights at the airport proper could well cause that cluster of lights to appear as a single focus and thus bring into being the condition so aptly described by P. P. Cocquyt's[3] "The Sensory Illusion of Pilots." Therein, the author explains the condition necessary to cause a pilot to believe that he is higher than he really is, and so invite quick disaster if at extremely low altitude, as was the case in the subject flight.

Briefly, the error in estimate of altitude stems from the fact that a nosed-up attitude of the aircraft causes a distant light or concentration of lights to appear lower (and the aircraft thus higher), and vice versa. This simple false illusion has demonstrably caused a number of accidents, and many near-accidents, under conditions of light and weather similar to those being encountered by Flight 636. Refraction, and apparent displacement, of lights through windshields, with many conflicting and confusing reflections, is another element that may have been involved. Another contributory factor could have been the unlighted water surface offering little or no visual stimuli for estimating altitude.

Notwithstanding the points mentioned above, there remains the fact that the pilot had two altimeters in the cockpit. It was disclosed that prior to landing at San Francisco the flight received and acknowledged the San Francisco barometric pressure of 29.90 in. There was no appreciable change in pressure between this time and the time of departure from San Francisco when both airports reported the pressure at 29.89 in. Therefore, it can be concluded that there was no possibility of erroneous altimeter setting existing as a factor in the accident. Why the pilot did not refer to the altimeter is unknown. Pursuing this trend of thought, there arises the question as to why the pilot did not follow the prescribed procedure of climbing to 2,000 feet and intercepting the northwest leg of Oakland range when he found it impossible to maintain visual contact at 500 feet.

In reviewing this accident, the Board concludes that the crew was definitely qualified to operate the aircraft. The evidence is conclusive that the aircraft was in an airworthy condition. It is, therefore, reasonable to assume that in the conduct of the flight the pilot permitted the aircraft to descend into the bay under a low and spotty overcast while maintaining visual reference to the distant shore, in the belief that he still was safely above the water. Obviously the pilot must have been misled by some form of optical illusion relative to altitude.

With regard to trans-bay operations, the Board, subsequent to this accident, inquired of the Administrator regarding the adequacy of the procedures prescribed for visual-contact flight, particularly with respect to four-engine aircraft. The Administrator has advised that this matter has been reviewed and re-evaluated both by the CAA and by a joint industry and CAA group since the accident, and they have concluded that the procedures in effect insure a reasonable degree of safety consistent with normal standards.[4]

Nevertheless, the Board is of the opinion

[3] Chief Pilot, Sabena.
[4] Footnote appears at bottom of p. 96.

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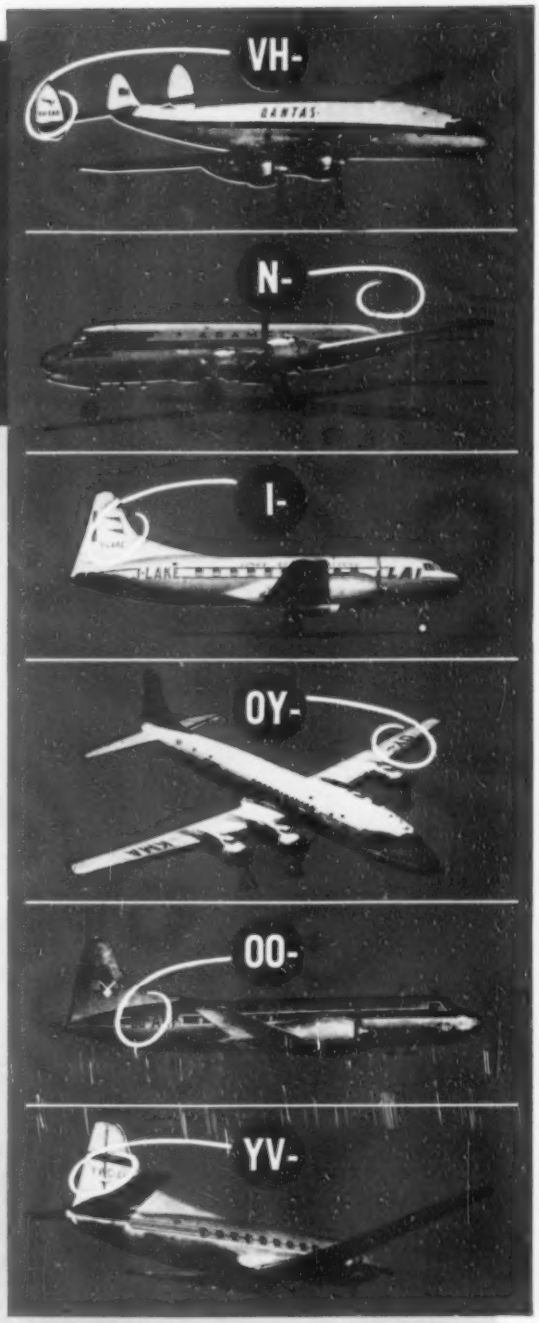

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*Australia	VH
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*Belgium	OO
* Belgian Congo	OO
*Bolivia	CP
*Brazil	PP, PT
*Burma	XY, XZ
*Canada	CF
*Ceylon	CY
*Chile	CC
*China (Taipeh Taiwan)	XT
*Colombia	HK
*Cuba	CU
Czechoslovakia	OK
*Denmark	OY
*Dominican Republic	HI
*Ecuador	HC
Egypt	SU
El Salvador	YS
*Ethiopia	ET
*Finland	OH
*France	F
*Greece	SX
Guatemala	TG
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*Iceland	TF
*India	VT
*Indonesia	PK
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Iraq	YI
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* Netherlands Antilles	PJ
* Netherlands Surinam	PZ
* Netherlands New Guinea	JZ
*New Zealand	ZK, ZL, ZM
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*Pakistan	AP
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*Paraguay	ZP
*Peru	OB
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that this operation requires special attention to insure that no relaxation of safety standards occurs in the conduct thereof, and further, the Board now has under active consideration the present regulation and procedures to determine whether any additional measures are required to insure an adequate margin of safety in trans-bay operations.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The company, the aircraft and its crew were currently certificated.
2. The flight was dispatched in accordance with the provisions of the Visual Trans-Bay clearance as outlined in the Joint Operations Letter—Revised effective Apr. 10, 1952.
3. The reported weather conditions at San Francisco and Oakland at the time of departure were above the prescribed minima.
4. Actual weather conditions over the bay at the time and place of the accident were later determined to be below the prescribed minima for trans-bay clearance.
5. The pilot of the aircraft failed to comply with the instructions provided in the Visual Trans-Bay procedures which are to be followed in case ceiling and/or visibility below prescribed minima are encountered en route.
6. No evidence was found of mechanical malfunction of the aircraft or any of its components recovered.
7. The flight descended below minimum specified altitude in an attempt to maintain visual reference.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the pilot's action in continuing descent below the 500-foot prescribed minimum altitude until the aircraft struck the water. A probable contributing factor to the aircraft striking the water was the sensory illusion experienced by the pilots.

BY THE CIVIL AERONAUTICS BOARD:

/s/ Oswald Ryan
/s/ Harmar D. Denny
/s/ Josh Lee
/s/ Chan Gurney

Joseph P. Adams, Member, did not participate in the adoption of this report.

---

[4] Section 61.261 of the Civil Air Regulations governing minimum flight altitudes specifies a minimum of 1,000 feet for VFR (Visual Flight Rules) operations "Provided, that other altitudes may be established by the Administrator for any route or portion thereof where he finds, after considering the character of the terrain being traversed, the quality and quantity of meteorological service, the navigational facilities available, and other flight conditions, that the safe conduct of the flight permits or requires such other altitudes."

This deviation authority has been exercised in four cases by the Administrator in authorizing lower VFR flight altitudes for the following routes:

1. Fort Worth and Dallas, Tex. (day and night).
2. Spartanburg and Greenville, S. C. (day and night).
3. Winston-Salem and Greensboro, N. C. (day and night).
4. San Francisco and Oakland, Calif. (day and night).

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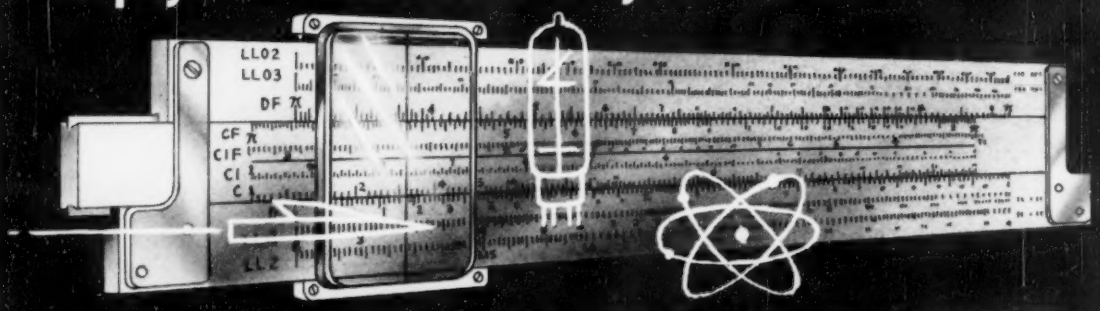

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AIR ARM DIVISION
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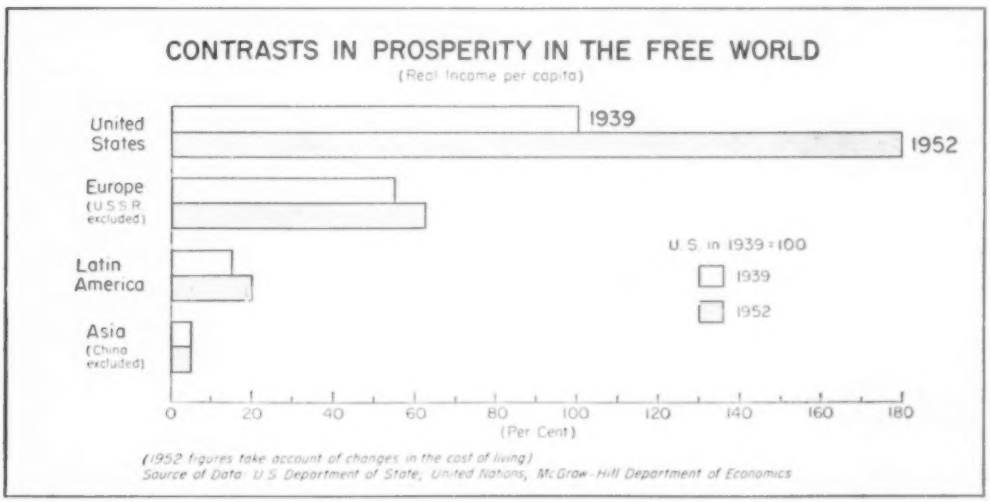
Contrasts in Prosperity Endanger the Free World

The chart in the middle of this page summarizes a situation of profound importance to every American. It shows that:

1. On the average, Americans are vastly better off economically than most other people in the free world, and
2. In recent years the gap in income between the average American and the average European, Latin American or Asian has greatly widened.

A Mounting Contrast

Even greater is the contrast between the real incomes of Asians and Americans. Today most Asians are no better off economically than they were back in 1939. On the other hand, the real income of the average American has almost doubled. As a result, the real income of the average Asian—always small by our standards—is now only a tiny fraction of that of Americans.



The chart shows that, at the outbreak of World War II, the real income (that is, actual purchasing power of income) of the average American was substantially higher than the average European's and much higher than the average Latin American's or Asian's. Since then, the European and Latin American have become better off. But the improvement in the economic lot of the average American has been so great that the others have been left far, far behind.

It must be remembered that the figures used to construct the chart are of varying quality. The fact is that few of the poorer countries have reliable statistics. However, it is generally agreed among competent observers, that the figures here presented offer a correct impression of the wide disparity in the average of real incomes between various parts of the free world. The figures, of course, have nothing decisive to say about spiritual and cultural values. In these, coun-

tries with relatively little material prosperity may be rich.

It is possible to draw a variety of morals from the story of lagging growth of income in other parts of the world. For one thing, it reflects the dynamic force of private enterprise. Private enterprise is characteristic of our economy far more than it is of most of the other free economies. The chart also reflects the fact that we are bountifully blessed with the natural resources essential to a high level of real income. Moreover, we did not suffer from the devastation and waste of two world wars as did many of the other free nations.

Narrowing the Gap

But perhaps the most important message which the chart conveys is one of warning. It warns that something must be done to narrow the gap in prosperity between America and other parts of the free world, if that world is to be united successfully in the struggle against totalitarian Communism. Writing in the HARVARD BUSINESS REVIEW, Kenneth E. Boulding recently put it this way:

> *"The crux of the problem is how to raise the three-quarters of the world that live on a low level to the high level of the other quarter, for it is precisely this wide disparity that makes our world so unstable. American-Russian relations, for instance [are] . . . complicated almost unbearably by the fact that each power is competing for the support of the vast fringe of underdeveloped countries . . . These countries are dissatisfied with their present state and are hovering between the two cultures, wondering which offers them the best chance of shifting from their present low-level to a high-level economy."*

Very real danger threatens from any feeling which may develop in the less fortunate free nations that our enviable economic progress has been made at their expense. Instead of viewing the American economic system as a model that might be followed by their own countries, they may be led to see in it a menace to their well-being. If Communist propaganda can persuade these people that their alliance with the free world will only result in their dropping farther and farther behind an increasingly prosperous United States, they will be driven to the side of totalitarianism.

Test of Effective Leadership

How can these free nations on the lower half of the income ladder be helped to alleviate the conditions that keep them there? Surely this question poses a whole series of complicated problems. Yet, if we do not exercise some effective leadership toward their solution, we can be sure that Russia will take advantage of the situation. In these circumstances, it is essential to both the stability and security of the free world that we help our less prosperous neighbors make satisfactory headway.

This does *not* mean that the United States should sacrifice its own economic progress in favor of some sort of global leveling scheme. On the contrary, a continually expanding and stronger economy is essential if we are to provide any real aid to our friends. Also, it goes without saying that our friends must be disposed to do all they can to improve their own economic position, if our cooperation to that end is to be effective.

Great Skill Required

Our part in a program to achieve this goal calls for a high degree of skill and statecraft. It involves international trade policy, which, in itself, presents a perplexing range of problems. It involves also programs of foreign technical and economic assistance. And expanded foreign investment must play a key role in a balanced program to strengthen the economies of the free world for our common good.

The Commission on Foreign Economic Policy, headed by Clarence Randall, has recently submitted a report, embodying the results of a monumental inquiry into our foreign economic relations and measures to improve them. From the very nature of the subject, discussion of the report is bound to be attended by much controversy and conflict. However, an awareness of the facts presented by this chart should inspire us to accord to the problems posed by the Randall Commission the careful and sober consideration they must have if any real progress is to be made in raising the general standards of human well-being throughout the free world. Our willingness and ability to do this have now become the real test of our statesmanship, both at home and abroad.

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Six Years Under Carmichael

Capital Educates Workers to Cut Expenses

- **Cost consciousness pays off in increasing profits.**
- **Program keeps airline on pay-as-you-go basis.**

By Richard Balentine

Capital Airlines, operating under president J. H. Carmichael's rules of safety, dependability and friendliness the past six years, has grown from a "very sick airline" to the sixth largest in the industry and its biggest year in history.

Here is how Capital stood at the end of 1953:

• **Operating income,** before taxes and non-operating deduction, was $3,078,493, an increase of $1,088,990 or 54.8% over the $1,989,503 recorded in 1952.

• **Operating revenues** totaled $45,580,821, highest in the company's history and representing an increase of $5,184,821 or 12.8% over 1952 revenues of $40,395,703.

• **Operating expenses** were $42,502,031, a $4,095,831 or 10.7% increase over the $38,406,200 of 1952.

• **Passenger revenue** increased $4.3 million or 12%; charter revenue climbed $353,000 or 43%, and cargo and mail revenue $435,000 or 14%. The airline carried 2,250,000 persons a total of 716,607,000 revenue passenger-miles, an increase of 12% in passengers and 11% in passenger-miles.

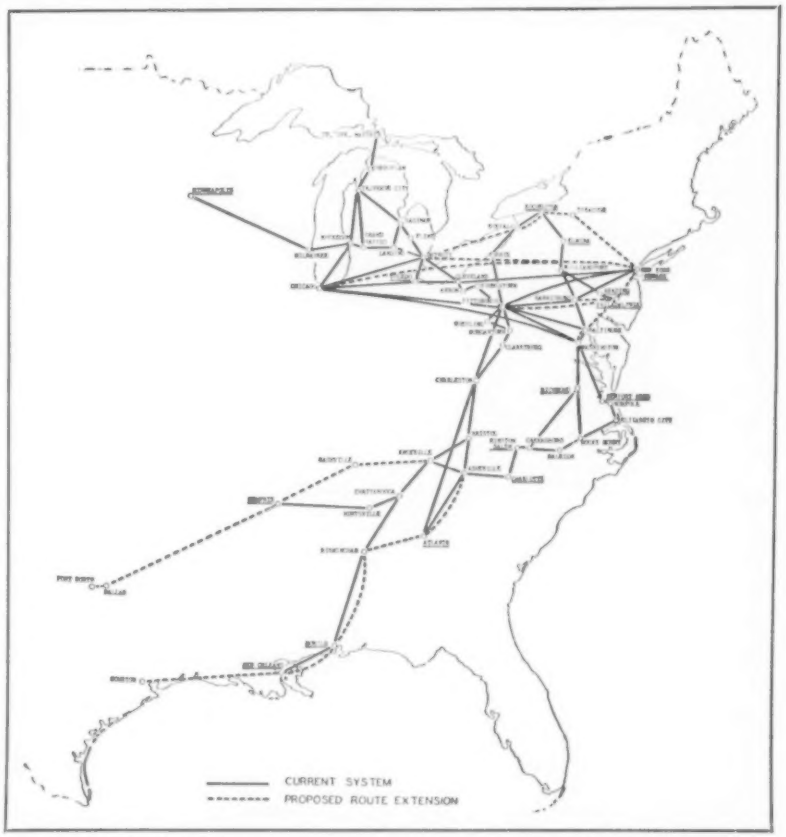
• **Record level** of passenger traffic was accompanied by an increase in the load factor of 2.5% over 1952.

• **Unit costs** of production per available ton-mile declined to 25.5 cents from 26.3 cents in 1952, or 3.4%, and the cost per revenue ton-mile dropped to 54.5 cents from 55.5 cents or 2%.

• **Total assets** amounted to $21,864,000, an increase of $2,465,000 over 1952. Working capital improved and cash at the year end was $4,128,000, an increase of $1,443,000.

• **Total capital** and surplus were $10,971,233 or $13.92 per share of common stock, compared with $9,331,456 or $11.91 per share at the end of 1953. This represents an increase of $2.01 per share in the net book value of the common stock.

► **Success Factors**—"It's hard to put your finger on one single reason for our success," Carmichael says. "It's



SHORTHAUL ROUTES make up Capital Airline's 5,160-mile, Canada-to-Gulf system.

BRASS BRIGADE takes over Capital station that exceeded monthly revenue quota. Carmichael (center) and presidential assistant Bob Averill (left) work the airfreight ramp.

more an accumulation over the years of several factors."

He cites these factors:

- Educating 4,434 employes to be cost conscious.
- Reducing the emphasis on its DC-3 aircraft.
- Increasing utilization of four-engine transports.
- Substantial increase of passenger, mail and cargo revenue.
- More high-revenue, low-cost charter business.

High on the list is the idea behind a motto that Carmichael has distributed widely throughout the offices and stations of his 5,160 mi. of routes. It reads: "Hold that expense line."

▶ **Scoffs at Recession**—Capital, formerly Pennsylvania Central Airlines, learned how to do that in 1947 when the airline's status forced Carmichael either to straighten out the economics or go broke. The success in bringing net earnings for 1953 to $1,652,289, $239,646 higher than last year, is attributed to his competency as an executive since he took over the presidency in 1947.

Talk of recession in 1954 is ridiculous to Carmichael. He predicts 1954 will be an even bigger year for Capital. He expects to do $51 million worth of business this year.

But no matter how big Capital Airlines becomes, its president insists the company will remain a "small, close-knit organization operating on a personal basis."

"Six years ago we all had to invest our lives in Capital so we all had the same stake in the future," he says.

▶ **Personal Visits**—At that time, Carmichael managed to travel around his routes meeting all Capital employes. Since then he has attempted to continue that personal contact so that "everyone knows everyone else's business at Capital."

Until he broke a vertebra in a riding accident in November on his 583-acre Leesburg, Va., beef cattle farm, Carmichael made frequent visits across Capital's routes. A neck-to-waist body cast and a smaller ankle cast, imposed when he broke an ankle in January, has slowed his activity.

▶ **Brass Brigade**—Any time a station on Capital's routes exceeds the revenue quota set by the front office for 12 consecutive months, Carmichael heads what he calls a "brass brigade" of top executives to that station and operates it for a day, giving the regular employes the day off.

Nine stations thus far have met or exceeded their quotas and the "brass brigade" has flown off to perform its duty. In this way the airline has prompted better business within its organization and proved its white-collar executives, many of whom worked up through the organization, still know how to make reservations, ticket passengers or load cargo.

CARMICHAEL hands baggage to Averill for loading aboard Capital DC-3 transport.

Carmichael dons white coveralls and works the cargo loading ramp on such occasions. A dinner in a local hotel or club follows for the quota-busting employes. The airline also has established "man of the year" awards for employes who, during any one year, make an outstanding contribution to the company.

▶ **Cutting Overhead**—To reduce costs over its shorthaul, highly restrictive routes, Capital has concentrated on cutting its overhead.

Through the past few years, personnel have been kept to a quota. Executives have doubled up on the administrative work load.

New procedures and devices have been found to streamline ticketing and reservation procedure to economize that operation while giving better service to the public.

▶ **Avoids Loans**—Equipment has been improved but only on a pay-as-you-go basis. The company has poured its earnings into equipment, preferring to avoid loans.

Capital recently took delivery on the last of 12 Lockheed Constellations, all of which have been financed through company earnings. Now that the last Connie has been paid for, the airline is able to show its earnings as profit.

Four were purchased in 1953 and all will be in service by Mar. 15. In addition, the company owns 24 Douglas DC-4s, 23 DC-3s, one C-54 and one C-47.

Increasing emphasis is being placed on four-engine equipment, because it gets more revenue over Capital's routes. The Capital DC-3 steadily is being shunted to the background and now is in use mostly on routes serving smaller airports.

For the future, Carmichael sees his airline sticking to the DC-4 and Constellation because "they best suit our needs." He is convinced that because of the shorthaul nature of Capital's routes, the type of terrain covered and the increasing amount of traffic developing, the DC-4 and Connie will remain the best bets for some time to come.

▶ **Studies New Equipment**—The Connie best meets Capital's competition on its blue ribbon routes, Carmichael says. A faster or bigger airplane is not required.

"However, we are keeping abreast of the new equipment being offered," he says. "The helicopter seems to be the next logical step in the shorthaul transport field."

But Capital's chief predicts the transport copter is several years away because of high operational costs.

The airline views its 55-passenger Constellations as big prestige aircraft. The first five were 049 models that KLM Royal Dutch Airline had turned over to Lockheed Aircraft Co. when it received delivery of its first Super Constellations. Lockheed Service Corp. redesigned the interiors to Carmichael's specifications.

Two others, 749 models, were converted by Capital and the remaining five were done over by KLM.

▶ **Charters Profitable**—Capital has discovered that charter business built up over the years, particularly hauling athletic teams, is continuing to reap dividends. This is seen as a high-revenue, low-cost operation. In 1953, Capital flew 680,449 charter-miles, from which it gained $1,101,460 in revenue.

The entire airline industry flew 2,466,720 charter-miles during 1953, received $3,926,932.

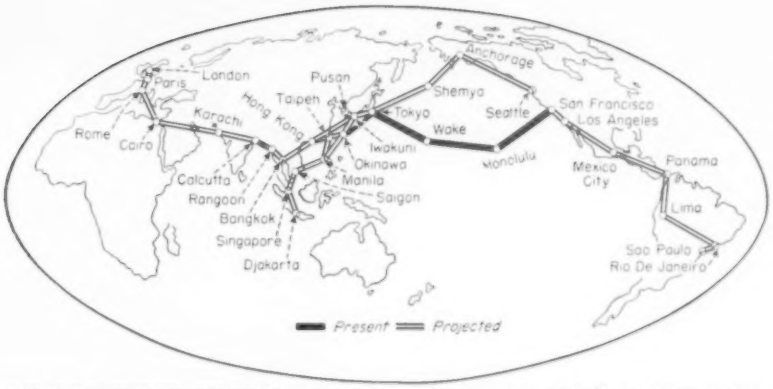
Capital holds a unique position in the industry. Servicing shorter hauls of the major routes throughout the East, the carrier figures it is the "dime store operation" of the industry.

▶ **Low Average Fares**—Average Capital fares are $17.80, compared to $29.77 for the entire industry.

Currently the company is endeavoring to realign its routes by getting some of the present restrictions removed.

It is involved in the current New York-Chicago route case before Civil Aeronautics Board and the Northeast-Southwest case. In the latter, Capital is attempting to gets its southern routes extended to Houston, Ft. Worth and Dallas.

Capital, meanwhile, continues to develop more and better service along its present routes, adhering to Carmichael's three ideals as the way to run an airline: safety, dependability and friendliness, in that order, while holding down and reducing costs where possible.



WORLD-WIDE NETWORK keynotes JAL's expansion plans, including jet-liner services.

JAL Seen as Tough Competitor

By A. W. Jessup
(McGraw-Hill World News)

Tokyo—"Wings of new Japan," DC-6Bs of Japan Air Lines, have stretched across the Pacific bringing a new, important and potentially tough competitor to the Far Eastern air routes. The accomplishment is remarkable considering that only a few years ago it was thought that Japan might never fly again.

JAL racked up two years of successful domestic operations as the prelude to the Japanese-flag invasion of international service with its present twice-weekly flights between the United States and Japan and between Okinawa and Japan. By the end of the year, plans call for extension of the U.S. route into South America via Mexico City, Lima and Rio de Janeiro to Sao Paulo and of the Okinawa route to Taipeh, Bangkok and Karachi.

▶ **U.S. Influence**—Ambitions for next year include regular service to London via Cairo, Rome and Paris, to Djakarta through Manila, Saigon and Singapore, and to Hongkong, Rangoon and Calcutta on the Karachi run. Also, on the planning boards are services over the North Pacific to Seattle, but this schedule probably will not begin until 1956.

American influence has been the dominant foreign factor in JAL's development, although the company wishes to develop its own techniques and programs. The American influence includes aircraft, maintenance and management factors. The latter is much less today than when the airline began Aug. 1, 1951. Equipment includes six Douglas DC-4s and three DC-6Bs. Two more 4s are desired, one probably will be delivered this month by Scandinavian Airlines System. Two 6s will be added to the fleet in the fall.

Maintenance is handled by Japan Aircraft Maintenance Co., Ltd., (Jamco) established by JAL in July 1952 in cooperation with Northwest Airlines and Transocean Air Lines (JAL owns 44% of the stock, Northwest 18.2% and Transocean 18%).

A staff of 12 American technical personnel was hired, including John Hann, former chief inspector for Transocean, as director of the maintenance plant, and Charles H. Hall, former Pratt & Whitney engineer, as advisor in the engine and propeller overhaul shop. The American staff is down to eight now and, before the year-end will be cut to three. Besides maintaining JAL aircraft, Jamco takes care of the maintenance and repair requirements here of Transocean, KLM, Air France, Sabena and Thai Airways.

▶ **Other U.S. Aid**—Because of hangar, shop and ramp space difficulties, Jamco will not begin maintaining the DC-6Bs until later this year. Heavy maintenance will be handled by United Air Lines in San Francisco.

In addition to legal advisers in the United States, JAL has an American operations consultant, Mal B. Freeberg, retired Northwest pilot. The Japanese are so anxious to run their own show completely that frequently they get themselves into difficulties before consulting Freeberg.

Throughout JAL's history there has been a running fear that foreigners would take over the airline. Newspapers repeatedly warn, as the Mainichi, one of the three leaders, did editorially last February: "The foreign personnel on the payroll of JAL should be replaced by Japanese employes and international lines established by Japanese airlines. . . . Capital cooperation with foreign countries may be more expedient, but we stand opposed."

▶ **Legal Restrictions**—JAL's executives have not been overbearing at all in this matter. But they have been forced by the country's natural patriotism to seek foreign advice last rather than first. Freeberg's contract took considerable writing and rewriting in order to make it conform to the country's law, which specifies that no one but a Japanese citizen can be an officer or possess managerial authority in a company of this sort. The final contract specifies that Freeberg cannot represent JAL except in specific instances as specifically delegated by the company executives.

Pride may have prompted the company to undertake a bigger expansion than its economics justifies. The routes it hopes to have in operation by next year are extensive. In addition, the Japanese want the best and latest equipment.

Thus, they have on order two de Havilland Comet 2s, and they give every indication of going through with this purchase despite sobering advice from outside to the effect that as new an airplane as the Comet with its additional risk factors might be a dangerous experiment for a young airline.

▶ **Loss Factor**—The big, experienced airlines can sustain the effects of a major plane loss with fatal casualties. A new airline, on the other hand, might take such a licking that it could not recover.

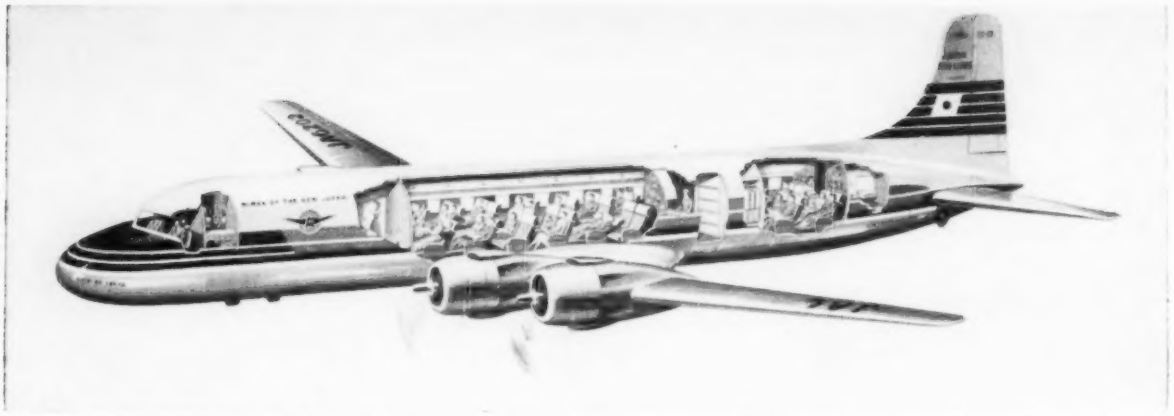
Perhaps JAL's domestic experiences have overcome their fear along this line. Early in the company's operations, one of its Martin 2-0-2s crashed into the side of a volcano on the island of Oshima at the mouth of Tokyo Bay. Despite this loss, business did not suffer for long.

Since that crash, the company has had no serious accidents. In the last 14 to 15 months, there has been only one "emergency" landing, and investigation revealed that this wasn't really an "emergency." The pilot thought he had some trouble but none was found after the aircraft was on the ground.

The domestic service was begun Oct. 25, 1951, using four Martin 2-0-2s and one DC-4 chartered from and manned by Northwest Airlines. Daily round-trips were scheduled from Tokyo to Osaka, Fukuoka and Sapporo. The company has since purchased its own fleet of Douglas airliners, plus three de Havilland Herons.

▶ **Performance**—Through Sept. 30, the company's performance records showed: 1,681,000 revenue-miles flown during fiscal 1953, compared with 1,182,000 miles the previous year; 172,956 revenue passengers, compared with 92,288; 68,958,686 revenue passenger-miles, compared with 38,339,000. Passenger revenue per passenger-mile and load factor for the first six months of fiscal 1952 were 4.5 cents and 74.7%; for the second half, 4.3 cents and 75.6%; for first half of 1953, 4.2 cents and 68.1%, and for the last half, 4.1 cents and 69.9%.

Mail and freight carried in 1952 totaled 326 tons. Last year it had more than doubled to 712 tons. Mail and



JAL'S PLUSH DC-6BS have 38 fully reclining seats and four separate rest rooms. During tourist season, planes will seat 61.

freight ton-miles flown jumped from 127,504 in 1952 to 295,216 last year. Freight revenue per ton-mile during the first six months of 1952 was 90 cents, second month 91 cents; last year it was 88 cents for the first half and 93 for the second. Performance rate went from 92% the first six months of 1952 to 97.5% the last half of fiscal 1953.

▶ **Financial Record**—Comparative records are not available here. But one wonders whether any similar airline has had such an initial success. In a strict sense JAL is Japan's first real commercial airline. So this period could be considered Japan's first two years in civil aviation. Financial record reveals a 100 million yen ($277,000) loss the first year with a break-even last year, against expectations of greater losses.

The Japan Air Transport Co., established in 1928 with government support, operated various routes from April 1929 until the beginning of the war. Officials of the old airline told AVIATION WEEK that theirs was primarily a service for the military and the government. A flight with 20 seats available, for example, would have six to eight seats reserved each for the navy and the army, and three to six seats reserved for other government agencies and bureaus.

Prewar international service aimed at fulfilling the transport requirements to the empire and military outposts. The first routes went to Shanghai and Nanking and Seoul, Chingtao and Peiping. Later, when Japan Air Transport was amalgamated with International Aviation Co. to form Dai Nippon Aviation Co., other routes were opened to Saipan, Palau and Timor, to Bangkok, and to Canton, Hanoi and Saigon.

▶ **Schedules**—With six DC-4s, JAL currently schedules two roundtrip flights daily to Sapporo, with stops at the big USAF base at Misawa on weekends; two roundtrip flights daily to Fukuoka via Osaka; and two roundtrip flights to Osaka, one of which goes via Nagoya. Night airmail service may be started shortly using three Beechcrafts.

American pilots man both domestic and international operations. But JAL hopes to use Japanese pilots in another year. Twelve are in training now and will fly as co-pilots shortly on the two runs. But it will take at least two years before Japanese pilots will be flying the Pacific.

Language problems are part of the holdback. The airways over Japan are manned by USAF personnel and English is the language. Japanese are in training to take over this system which will be turned over completely to Japanese operation when the U.S. security forces are withdrawn. Until then, however, English will be the sole language in use, so pilots and crew members must be fluent in English.

Other problems for JAL are the cramped space at airports in Japan, especially at Haneda, the Tokyo international airport. Only 3-4% of the available space is in JAL hands, and they are restricted in how it can be used. USAF installations for MATS and Far East Air Forces still take up the lion's share of hangars and ramps. Much hangar space is utilized for recreational and other non-aeronautical pursuits much to the annoyance of Japanese.

▶ **Korea Influence**—In part, the sudden impact of the Korean war was to blame. In late spring of 1952, U.S. forces were unextending themselves, preparing for the eventual withdrawal from Japan. MATS, which based at Haneda, stopped its building programs and expected to move to another temporary base.

When the North Korean Communists invaded South Korea, all was changed. MATS began the biggest airlift in history, using both its own aircraft and contract aircraft from U.S. airlines. Haneda was MATS terminus and, instead of withdrawing, MATS business boomed.

Only since last fall has the lift dwindled, but MATS still hangs on and because of the clutter at other USAF bases is unable to move. This is understandable. What isn't understandable are the many little irritations which seem to make no sense whatever. JAL is allotted a ramp space right in front of its domestic terminal, but it cannot refuel aircraft on this spot because MATS has a ruling that its own aircraft can't be refueled on the ramp.

So, when a flight comes in from Sapporo with the aircraft scheduled for further flight in 30 min. to an hour, instead of refueling it where it is parked, JAL or Jamco (which handles the aircraft of the ground) must tow the plane away, refuel it and then tow it back. MATS can't give any better reason for this requirement than the excuse that its planes are not allowed to be refuled in the same position.

▶ **Inconveniences**—Sometimes a USAF plane may be parked on the JAL spot, then the JAL plane must be spotted farther down the ramp, its passengers having to hike to or from the airplane, even in foul weather. So far, the Japanese have given the appearance of understanding and putting up with the inconveniences which stemmed from the emergency requirements of the Korean war. But that is over now, and unless some corrective actions are taken soon to let Haneda appear to be a Japanese airport in fact as well as in name, trouble in the form of bitter words and propaganda will follow.

JAL's planning group, headed by Ryohei Itow, thinks that Japan has been lucky in its cycling into the world air transport picture. JAL starts out with DC-6Bs for the international service, and expects to put Comet 2s into operation next year. By that time they expect that the bugs will be ironed out of the jet-liner and that the problems of trans-Pacific utilization will have been worked out by Canadian Pacific Airlines which is starting Comet serv-

ice from Vancouver to Australia via Honolulu.

► **Comet in Future**—Here's how Itow, who is American-schooled, and his staff figure: If CPA is successful, then JAL should be able to inaugurate Tokyo-to-Honolulu-to-San Francisco jet operations soon after its Comets are delivered.

They believe that the Comet 2s they will receive can carry a full payload on the Pacific via Wake, except during the January-March period when headwinds westbound would require modification of the flight load. Otherwise, they expect to carry 44 passengers in first-class service. Then, JAL would place its DC-6Bs in full tourist service.

Should the Pacific operation not prove immediately feasible, JAL would use the Comet in service to London.

In the meantime, JAL expects to run split service on its DC-6Bs. The aft compartment would provide deluxe, first-class service for 12 passengers. There would be 47 passengers forward in tourist class.

Some difficulty is anticipated, however, in keeping the tourist passengers happy with box lunches while the luxury passengers are being served full-course hot meals, plus cocktails.

► **Tourist Charters**—During the coming April to May, Japan's spring flower-viewing and cherry blossom time, JAL will run special tourist charter flights from Honolulu to Tokyo and return. Groups will be able to obtain a per-passenger roundtrip fare of $360, according to Itow. This figure is based upon a 61-passenger load.

In the long-term picture, JAL is looking at both the Comet 3 and the Britannia. If the two are equal, then JAL expects to use the Comet 3, since it will have been using the 2.

There has been some temptation to seek basic DC-6s, too, since they are using DC-6Bs, and therefore the maintenance and supply problems would be lightened and training expenses reduced.

But JAL is intent upon entering the jet transport age. Itow pointedly remarked that he had been told Douglas had just ripped up its 17th mockup on the DC-8, implying that U.S. aircraft manufacturers are behind, in his opinion.

One of JAL's best selling points in the future may be its passenger service on the ground and in the air. They have set out to provide services comparable to that of the top prewar Japanese shipping lines: Osk and Nyk, which were noted for superior service. If this can be done, then Japan Air Lines should take a front place in air service in the Far East. The line certainly put on an impressive demonstration flight for visitors from the United States last month.

SHORTLINES

► **British Overseas Airways Corp.** reports January's passenger traffic exceeded volume for the same month in 1953 by 12.6%.

► **California Central Airlines** had a 10.1% gain in system load factor and a 20.3% gain in route miles flown for January 1954, compared with January 1953.

► **Denver's Stapleton Field** recorded a 26% increase for 1953 in number of persons boarding planes and a 5% gain in aircraft movements. Mail movements increased 5.5%, express 2% and freight 36%.

► **KLM Royal Dutch Airlines** is opening a sales office at Salt Lake City, Utah.

► **Lake Central Airlines** reports a 72% increase in passenger sales for 1953 over 1952. Passenger boardings for January 1954 show an increase of 132% over the same month last year.

► **Pan American World Airways** set four speed records over Alaskan routes this month, flying DC-6Bs: Fairbanks to Seattle, 4 hr. 5 min.; Annette Island to Juneau, 1 hr. 12 min., returning in 1 hr. 1 min.; and Annette to Seattle in 2 hr. 50 min.

► **Pioneer Air Lines** reports a 46% increase in passenger volume for January 1954 over the first month of last year, flying 281,668 miles to complete 96.29% of the total miles the carrier scheduled.

► **Port of New York Authority** will extend the dual-lane Van Wyck approach road at New York International Airport together with access roadways by about three-fifths of a mile. . . . PNYA also has awarded two construction contracts totaling $98,590 for power and lighting improvements on the airport's Instrument Runway 4-22.

► **Russia** has completed a new air terminal at Kazan, key industrial city east of Moscow on USSR's transcontinental routes, according to Pravda.

► **Seaboard & Western Airlines** reports a 17% gain in commercial and military operations across Atlantic and Pacific routes for 1953 over 1952. The carrier logged 8,290,727 revenue-miles in 41,904 hr. in 1953, with a fleet utilization average of 12.3 hr. per day.

► **Swissair** announces a 130,000 increase in passengers carried in 1953 over 1952.

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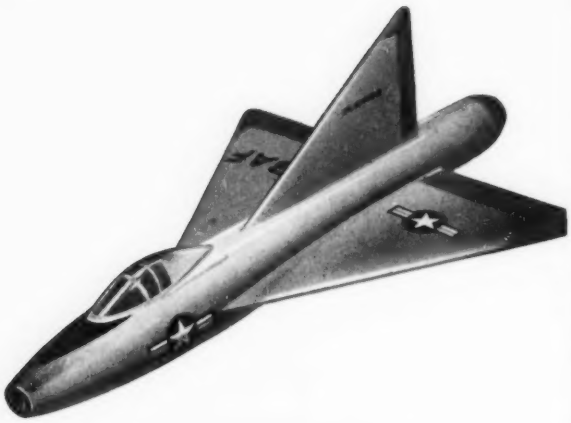

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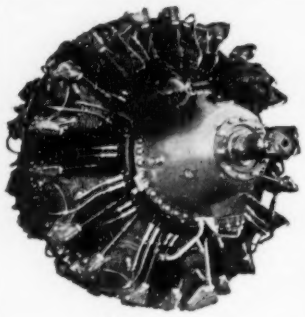

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Description	Mfg.	Part No.	Quan.
Heater	Surface Combustion Co.	83A9	6
Heater	Stewart Warner (200,000 BTU)	921B	230
Blower	Dynamic Air Engine	4582-AA-6C	18
Blower	Joy Manufacturing Co.	U-702-15	24
Tank Unit	Minn. Honeywell	G-1098D	11
Trim Tab Controller	Pioneer	15701-1A	15
Oil Cooler Assembly	U.A.P.	U8416-MM	12
Oil Cooler Assembly	U.A.P.	U8013-MM	14
Hydraulic Pump	Vickers	MF9-713-15H	120
Hydraulic Pump	Vickers	PF12-713-25BCE	124
Hydraulic Pump	Vickers	PF4-713-20BCE	327
Hydraulic Pump/3000 P.S.I.	Vickers	MF45-3911-20Z	43
Hydraulic Cylinder	Air Associates	HC2109	29
Hydraulic Cylinder	Air Associates	HC2110	8
Fire Detector	Edison	117-47	46
Fire Detector	CO_2 Mfg. Co.	ASDC2	65
CO_2 Cylinders	Kidde	981280	185
CO_2 Cylinders	Kidde	M870016B	47
Anti-Icer Pump	Adel	D7818	125
Auxiliary Power Unit	Eclipse	NEP-2	29
Auxiliary Power Unit	Lawrence	LER-30D	16
Pump	Pesco	1E-621	8
Pump	Pesco	2E258SA	21
Separator	Pesco	3V-217-HC	32
Accumulator	Vickers	AA14002A	35
Actuator	Air Associates	M-2031	22
Wobbie Pump (D-3)	Erie Meter	AN4014	17
Oxygen Cyl.	Kidde	923748	74

ENGINE ACCESSORIES

Starte	Eclipse	1416-12E	75
Generator	Eclipse (NEA-3A)	716-3A	100
Starter Motor	Jack & Heinz	JH950-R	90
Generator	G.E.	2CM46A2	4
Generator	Eclipse	1003-4	71
Carburetor	Stromberg	PD12K10	550
Carburetor	Stromberg	PR48-A1	236
Carburetor	Holley	1685-HAR	90
Carburetor	Holley	1375-F	19
Magneto	Scintilla	SF9-LN-2	407
Fuel Pump	Pesco	2P248EB	6
Fuel Strainer	U.A.P.	U635A	76
Governor	Woodward	5x18	10
Prop. Reversing Control	Ham. Standard	72400	20
Oil Separator	Eclipse	564-2A	384
Oil Filter	Purolator	27314	100
Pressure Relief Valve	Aerotec	V301B7	20
Tachometer	Eclipse	2227-11-D3A	11
Vacuum Pump	Eclipse	610-2C	6
Spark Plugs	Aero	LS4-AD1	185,000

AIRCRAFT ENGINES & PARTS

Engine	Wright	R-1820-52	1
Engine	Wright	R-1820-54	16
Engine	Wright	R-1820-60	4
Engine	P & W	R-1830-43	1
Bearing	P & W	1045A	166
Flange	P & W	3506	500
Follower Assy.	P & W	8288	130
Blower Assy.	P & W	3M814	814
Shaft	P & W	48362	53
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Gear	P & W	48461	390
Gear	P & W	76236	78
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Housing	P & W	84487	113
Nose Housing	P & W	84591C	77
Crankcase Assy.	P & W	84350-D	200
Pump Assy.	Wright Aero	420313	33
Drive Assy.	Wright Aero	416421	46
Q.E.C. Unit		FM1	36

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Description	Mfg.	Part No.	Quan.
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Bearing	Torrington	NR6L12	25790
Bearing	Fafnir	AN200-K3L2	18273

GAUGES

Compass	Eclipse	36001-0	20
Gyro Indicator	Eclipse	14601-1F-B1	11
Gyro Indicator	Eclipse	10078-1AG	62
Position Indicator, Wheel & Flap	Weston	AN5780-2	400
Position Indicator, Wheel & Flap	G.E.	AN5780-2	1000
Position Indicator, Wheel & Flap	Eclipse	20100-11C-4-A1	23
Pitch Trim Gauge	Eclipse	15100-1B-A1	19
Cowl Flap Indicator	G.E.	8DJ29AAY	21
Oil Temp. Indicator	Lewis	77C3	23
Oil Temp. Indicator	Lewis	77C4	13
Oil Temp. Indicator	Weston	828TY13Z2	71
Manifold Pressure Gauge	Manning, Maxwell & Moore	AN5770-2	28
Fuel Quantity Gauge	Eclipse	3801-3B	128
Dual Carb. Temp. Gauge	Weston	828TY12Z2	40
Carb. Air Temp.	Lewis	77C3	22
Carb. Air Temp.	Weston	119862	40
Air Temp. Gauge	Weston	727TY70Z2	11
Air Temp. Gauge	Weston	727TY72Z2	85
Air Temp. Gauge	Weston	727TY73Z2	88
Air Temp. Gauge	Weston	727TY74Z2	83
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Air Temp. Gauge	Lewis	47B22	33
Air Temp. Gauge	Lewis	47B23	28
Air Temp. Gauge	Lewis	47B24	54
Air Temp. Gauge	Lewis	47B21	30
Cylinde- Head Temp.	Lewis	76B19	8
Torque Indicator	Eclipse	20100-42B-14A2	9
Tachometer Indicator	G.E.	8DJ13ABK	6
Tachometer Indicator	Eclipse	2222-1F-2A	200
Magnesyn Pos. Indicator	Eclipse	20000-8-A14	9
Magnesyn Transmitter	Eclipse	20000-43A-13A1	8
Magnesyn Indicator	Eclipse	23000-2A	67
Pressure Transmitter	Eclipse	22101-11-A4	15
Pressure Transmitter	Glenniní	47114-D2.0-20	8
Differentia- Pressure Gauge	Kollsman	906-6-011	22
Differential Pressure Gauge	Kollsman	254BK-6-052	48

AIRCRAFT (RADIO)

Transmitter	Bendix Radio	TA-12B	20
Receiver	Bendix Radio	RA10-DB	35
Amplifier (PB10) W/ED2 Mount	Eclipse	15401-1	10
Amplifier	Eclipse	12086-1C	11
Radio Noise Filter	G.E.	1C-200	740
Radio Noise Filter	G.E.	NF10084	959
Tube		JAN6AL5	327
Standing Wave Ind.	Hewlett Packard	415A	3
Antenna Switch	Bendix Radio	MS49A	26
Control	Bendix Radio	3616	81
Station Box	Bendix Radio	3620	23
Insulator	Bendix Radio	MT48C	518

ELECTRICAL PARTS

Transformer	Eclipse	DW33	11
Transformer	Eclipse	DW28	80
Transformer	Eclipse	DW47	33
Transformer	G.E.	70G3	26
Servo Motor	Transicoil	#1300-20	57
Motor	G.E.	5BA40NJ1A	425
Motor	G.E.	5DP65-MB1	189
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Circuit Breaker	Spencer	PM-5	2094

ELECTRICAL PARTS (Cont.)

Description	Mfg.	Part No.	Quan.
Circuit Breaker	Spencer	C6363-1-5A	113
Circuit Breaker	Spencer	C6363-1-2A	118
Circuit Breaker	Heinemann	AM1614-80	1700
Circuit Breaker	Cutler Hammer	6141-H69A	237
Amplidyne	G.E.	5AM31JJ9A	31
Amplidyne	G.E.	5AM31NJ10	111
Switch	Kidde	A-4614	151
Ignition Switch	Scintilla	AN3213-1	70
Ignition Switch	Nesco	A-9(94-3226)	250
Master Switch	Jos Pollack	M862A	66
Thermo Switch	Fenwall	17322-2	126
Heater Control Switch	White-Rodgers	1033-4E1	287
Air Ram Switch	Minn. Honeywell	PG208AS1	148
Air Ram Switch	Minn. Honeywell	PG208AS7	40
Pressure Switch	Aerotec	M-101-B	20
Pressure Switch	Eclipse	3135-11C	88
Impact Switch	Kidde	SA/3A	18
Switch	C.H.	B809-K99	2000
Dome Light	Grimes	AN3096-4	2585
Dome Light	Grimes	AN3096-5	775
Dome Light	Grimes	AN3096-6	1365
Plug	Cannon	NAF310310-4B	2747
Plug	Cannon	NAF310310-5B	402
Relay	Leach	7264-404	47
Relay	Leach	7210	24
Relay	Allied	BOBX-2	31
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Compensator	Vapor Car Heating Co.	468311	23
Solenoid	Interstate Aircraft & Eng. Co.	AB12	202
Flex. Cable	Airesearch	25432	66
Temp. Control	Fulton Syphon	715E	52
Noise Filter	Mallory	NF3-5	500
Regulator	G.E.	3GBD1A18A	13

VALVES

Valve	Kidde	982585	326
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Valve	Whittaker	AN5830-1	335
Valve	Whittaker	AN5830-6	74
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Valve	Eclipse	612-4A	130
Valve	Kohler	K1503-6D	1888
Valve (0-500PSI)	Bendix	146102	46

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Case Against Auto Feathering

Recent crash of a Convair 240 at Buffalo may bring to a head a long-standing feud over automatic propeller feathering. This device became mandatory on 240s in order that the airplane might meet certain single-engine climb specifications of T-category.

It was felt that manual feathering would be too slow for safety. Single-engine-wise, the 240 is a great deal like the DC-3. That is, it will fly nicely on one engine with a couple of "ifs": if sufficient flying speed has been obtained prior to engine failure, and if the propeller is feathered immediately. On either airplane, a windmilling prop will bring the operation to a screeching halt.

► **Procedure**—Many DC-3s flew for years with a hydraulic feathering system, operated by a set of four valves in the companionway which, for good reasons, was known as the plumber's nightmare.

For those unfamiliar with the procedure, a feathering was accomplished by: 1. The co-pilot leaving his seat; 2. facing the rear; 3. selecting the appropriate "steam" valve handle; 4. rotating this handle a certain number of turns; 5. observing the propeller and, when the blades had feathered, 6. closing the valve.

The actual maneuver takes considerably longer to complete than to describe—even when the co-pilot chooses the correct handle on the first try.

The point is well taken by both pilots and airline management that if a wonderful safety record could be produced with this type of snafu then the Convair's "push button" feathering, manually operated, can do no worse. Industry-wide there have been somewhere near 400 false, or unwanted, featherings. That is, propellers have been feathered automatically on perfectly normal, healthy engines simply because the automatic gadget went haywire. One airline alone has had nearly 150 falsies against two actual engine-failure featherings—a 75-to-1 ratio.

► **Changes Its Mind**—Sometimes, you see, this damnable device not only feathers a good engine but then changes its mind and starts to unfeather it and maybe even repeats the cycle a few times. All of this is hard on the airspeed—what's left of it. Or, for no apparent reason, it may up and feather the good engine, leaving the pilot with one that is really bad.

What's the answer? Why, remove it, of course. Or, more correctly, change it. Instead of having automatic feathering, let's have automatic indication. That is, the device will turn on a light inside the manual feathering button as well as a light (one for each engine, please) over the BMEP gages. Now the pilot will have automatic warning and, if engine instruments, vibration etc. indicate the need, he can have instant feathering simply by depressing the lighted button.

The reason for having two separate lights, besides guarding against bulb failure, is an attempt to provide at least one light that the pilot can see. Ambient light conditions being what they sometimes are in the cockpit, it occasionally is necessary for a pilot to cup his hands around a warning light to make sure that it really is lit. Just about the time you find all this is true, you may also find yourself on single engine.

► **Change Needed**—Earlier, I said there was somewhat of a feud over this item. Actually, it is more in the nature of a fume by the users. All concerned—pilots, airlines, many CAA safety agents and CAB personnel, and others—have long agreed that a change is needed.

But this agreement hasn't changed the official rule still on the books. Of course, many pilots have been doing something about it by keeping the automatic feathering turned off. They reason that they would just as soon be illegally alive—if its all the same to CAB.

AVIATION CALENDAR

Feb. 22-23—Seventh annual National Model Plane Exhibit Contest, sponsored by Air Foundation and Cleveland Chamber of Commerce, Higbee Co. auditorium, Cleveland.

Feb. 24-26—Ohio-Indiana Agricultural Aviation Conference, Ohio State University, Columbus, Ohio.

Mar. 5-7—Society of Women Engineers, national convention, Mayflower Hotel, Washington, D. C.

Mar. 22-25—Institute of Radio Engineers national convention, Waldorf-Astoria Hotel and Kingsbridge Armory, New York.

Mar. 29-31—Aero Medical Assn., 25th annual meeting, Statler Hotel, Washington, D. C.

Apr. 5-6—Society of the Plastics Industry (Canada), Inc., 12th annual conference, Mount Royal Hotel, Montreal.

Apr. 5-8—American Management Assn., 23rd National Packaging Exposition, Convention Hall, Atlantic City, N. J.

Apr. 12—Society of Automotive Engineers, second annual Aeronautic Production Forum, Hotel Statler, New York.

Apr. 14—National Advisory Committee for Aeronautics, symposium on helicopter research for American Helicopter Society, Langley Field, Va.

Apr. 14-16—Society for Experimental Stress Analysis, spring meeting, Netherlands Plaza Hotel, Cincinnati.

Apr. 19-20—Symposium on automatic production of electronic equipment, sponsored jointly by Stanford Research Institute and USAF, Fairmont Hotel, San Francisco.

Apr. 21-24—Second annual student paper competition for undergraduates and graduates, sponsored by Institute of the Aeronautical Sciences (Texas Section), Melrose Hotel, Dallas.

Apr. 22-23—Joint meeting of Radio Technical Commission for Aeronautics, Franklin Institute Laboratories, Institute of the Aeronautical Sciences (Philadelphia Section) and Institute of Radio Engineers (Philadelphia Section), Philadelphia.

Apr. 22-23—American Institute of Electrical Engineers, conference on feedback control, Claridge Hotel, Atlantic City, N. J.

Apr. 29-30—American Society of Tool Engineers, 10th biennial industrial exposition, Convention Center, Philadelphia.

May 3—Invention Exhibit & Conference, Cleveland Engineering Society building, Cleveland.

May 4-6—1954 Electronic Components Symposium, Department of Interior auditorium, Washington, D. C.

May 5-7—Third International Aviation Trade Show, managed by Aircraft Trade Shows, Inc., 71st Regiment Armory, New York.

May 5-7—American Welding Society, second Welding & Allied Industry Exposition, Memorial Auditorium, Buffalo, N.Y.

May 16-19—American Association of Airport Executives, convention, Louisville, Ky.

May 17-20—Basic Materials Conference, produced by Clapp & Poliak, Inc., International Amphitheater, Chicago.

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EDITORIAL

The Lindbergh News

It is heart-warming news that President Eisenhower, for the Air Force, has nominated Charles A. Lindbergh for appointment as brigadier general in the Air Force Reserve. This would restore his commission, with promotion from colonel.

Among the shrill accusing cries today of rampant character assassination, the smear, and a new intolerance of those who dare to think differently from the crowd, it is rewarding to Col. Lindbergh's friends to see an earnest attempt by the President of the United States to help right a wrong, committed in 1941 by another President who enjoyed the label of "liberal."

President Roosevelt, in a denunciation of "defeatists," "appeasers," and "political copperheads," specifically classified Mr. Lindbergh among them—because he had dared to speak his mind. Lindbergh had been warning of the might of the German air force, which he had inspected in 1936, and he further warned his country to stay out of the world war he knew was coming.

His war record is well known, best told by Lauren D. Lyman, vice president of United Aircraft Corp., a friend of Lindbergh's, in the company's Bee-Hive magazine in 1950.

As the retired Far East air commander, Gen. George C. Kenney, commented: "This action is highly deserved and a long time coming."

Defense Plant Dispersal

What is the Eisenhower Administration's policy on dispersal of defense plants as a security measure in case of enemy attack? The matter was brought up again by Col. Charles Lindbergh in his recent address before the Institute of the Aeronautical Sciences in New York.

At that time, he said, "We must spread out our factories and we must keep in being fleets of aircraft which can strike an enemy more effectively than he can strike at us."

AVIATION WEEK immediately requested a quick spot-check of the Eisenhower Administration's current views on this subject so vital to the aircraft industry and to communities such as Los Angeles, Seattle, and Wichita.

How do the "new look" at airpower and the Administration's civil defense philosophy impinge on defense plant dispersal, once pushed so aggressively by federal policy? The survey indicates that there is no plan, nor were there up to 10 days ago any indications of such a plan, for promoting the dispersal of prime aircraft, engine or other general defense plants as a security measure.

One general officer, after discussing the matter throughout the Air Force, and with a member of the secretariat, added: "We do, however, try to look carefully at subcontracting, to accomplish the purpose of dispersal wherever possible.

"In subcontracting, we attempt to balance the possible value of dispersion against its costs. Obviously, we must also consider the advantages of additional sources of supply. For example, in the case of the Boeing B-52 at Wichita, we would probably attempt to obtain subcontractors in the general area of Wichita, as far as practicable. Subcontracting for Boeing at Seattle would be sought in the West Coast area. But as for doing this entirely for dispersal purposes, the answer is no. It would be too costly. We seek dispersal only if it doesn't cost too much. Production know-how and adequate labor forces are deemed more important in present thinking here."

Of course, the Administration will keep its so-called satellite centers operating—such as the airframe plants at Tulsa, Fort Worth, Marietta. These will be maintained at an operational level, rather than being held as idle standbys.

Nevertheless, there are still many persons in some important berths in government who still believe in more widespread dispersion of defense plants, and the latest evidence of new, long-range Russian bombers—revealed last week by AVIATION WEEK—is not likely to calm these individuals. They are frightened by what could happen to aircraft production after one or two well-placed atom or hydrogen bombs. They point out that whereas before the Russian development of atomic weapons the enemy could cripple a plant, now it might well remove one at a single blow.

The fact remains, however, that this has not yet inspired anyone in top planning levels in Washington to attempt to apply the kind of pressure exerted several years ago to encourage plant dispersion by implied or direct action of government.

Age Before Beauty?

The newspapers have just discovered American Airlines' ticklish and delicate problem resulting from its pronouncement that 32 is too old for its stewardesses. Our readers were apprised of this tumultuous decision last Jan. 4.

American has asked all its stewardesses of 32 or over to resign. Many have protested. So has the stewardesses' own union.

So, also, has one of our staff, a young bachelor known and admired for his friendly and discerning ways with gentle-women, as well as for his intelligent and level-headed grasp of some of the complexities of aviation.

Because we believe he is an expert, and not alone in his views, we quote his earnest memo to us, requesting an editorial on the subject:

"Reference the current hassle between American and its stewardesses: Stewardesses play an important role in reassuring new air passengers, in managing occasionally difficult passengers, in directing passenger rescue evacuation in emergency or accident. This all demands maturity and competence. To put it bluntly, I'd rather have an orderly, safe exit from a ground-looped plane with an old (34-year-old) stewardess than be trapped inside with even Marilyn Monroe. In recent months, I've flown largely with the "sweet young things,"—beautiful, yes—but they hardly knew which end of the plane was the front. And what's worse, they showed their immaturity and ignorance. In the air, I'll take maturity in preference to beauty or youth any day."

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—Robert H. Wood

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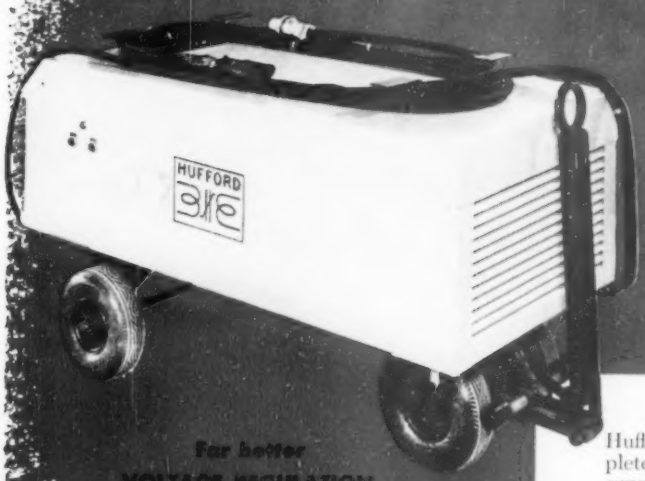

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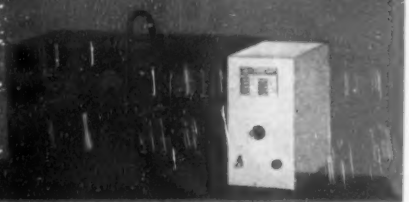

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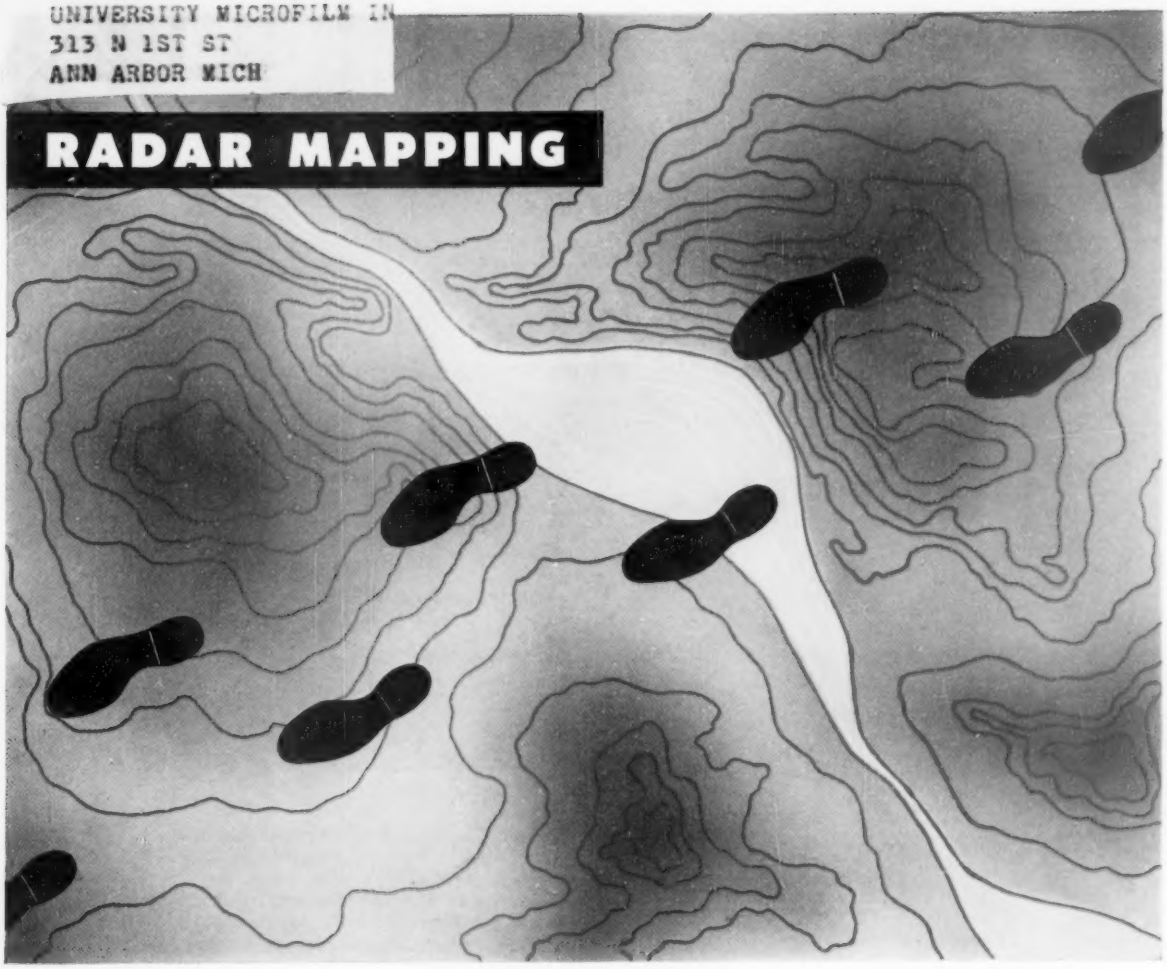

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